MARINE REVIEW

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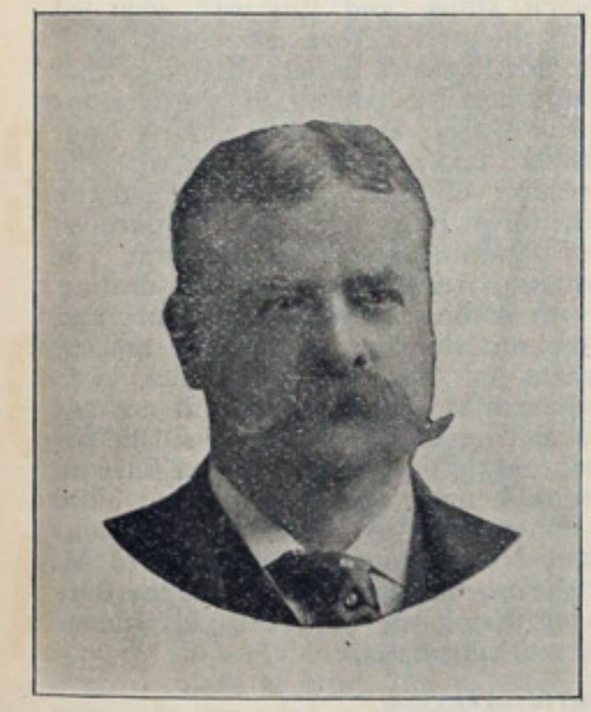
NAVAL ARCHITECTS.

ANNUAL MEETING OF THE SOCIETY IN NEW YORK, MADE NOTABLE BY THE PRESENTATION OF A MAGNIFICENT PROGRAM OF PAPERS—PROBLEMS PRESENTED BY THE LATE WAR BRING OUT DISCUSSION OF A MOST VALUABLE AND INTERESTING NATURE.

TORPEDO-BOATS, DESTROYERS, SUBMARINE CRAFT AND AUXILIARY NAVAL VESSELS PROVE THE PRINCIPAL TOPICS FOR CONSIDERATION. — LARGE INCREASE IN MEMBERSHIP.—NOTABLE ANNUAL ADDRESS BY PRESIDENT GRISCOM. — THE ANNUAL BANQUET.—THOSE IN ATTENDANCE.

An attendance above the average, an interesting program and lively discussions, engendered to a certain extent by the problems growing out of the naval operations of the recent war, combined to make valuable and profitable the sixth annual meeting of the Society of Naval Architects and Marine Engineers, held in New York last week. Through the courtesy of the president and managers of the American Society of Mechanical Engineers, the meetings were held in the auditorium at 12 West 31st street. President Clement A. Griscom called the meeting to order at 10:30 o'clock Thursday morning Nov. 10. The order of business was taken up by the presentation of the report of Mr. Francis T. Bowles, secretary and treasurer of the society. His report showed an enrollment of 541, divided as follows: Active members, 319; associates, 195; juniors, 18; life members, 6; life associates, 3. During the year the society lost four members by death and four members and five associates by resignation. The deaths of members recorded were those of Rear Admiral Daniel Ammen, John H. Dialogue, Charles E. Emory and John F. Pankhurst. The resignations submitted were those of Arthur Beardsley, John T. Henthorn, John E. Jeffries and Leo Morgan, as members, and Thomas J. Allen, John R. Bartlett, Theodore W. Cramp, Albrecht Hesse and Samuel Seabury, as associates. A statement of the financial condition of the association showed that there was on hand on Nov. 9, 1897, a balance of $2,595.14. The receipts during the year were $4,728.97 and the total expenditures, $3,682.48, leaving a balance on hand on Nov. 9, 1898, of $3,641.63.



PRESIDENT CLEMENT A. GRISCOM.

This report was embodied in that of the council of the society as having met with approval at the session of that body on the afternoon previous. The council also recommended favorable action, which was immediately taken, upon the applications of fifty-five gentlemen for affiliation with the society in one way or another. The list of new members is as follows:

LONG LIST OF NEW MEMBERS.

George F. Coleman with Moran Bros. Co., Seattle, Wash.; Albert Charles Diericx, chief draughtsman American Steel Barge Co., West Superior, Wis.; Albert C. Engard, chief engineer, U. S. N., Philadelphia, Pa.; W. D. Forbes, W D. Forbes & Co., Hoboken, N. J.; Daniel Edward Ford, assistant general manager American Steel Barge Co., West Superior, Wis.; William E. Keough, consulting engineer, East Boston, Mass.; James J. Killilea, superintendent of construction United States light-house establishment, East Boston, Mass.; John Leonard, passed assistant engineer, U. S. N., Navy Yard, Brooklyn, N. Y.; George Muller, leading draughtsman hull department, Wm. Cramp & Sons, Philadelphia, Pa.; Richard Lane Newman, general manager Globe Iron Works, Cleveland, Ohio; John Platt, Thorpe, Platt & Co., New York; John D. Torrey, draughtsman, bureau construction and repair, navy department, Washington, D. C.; Josiah Wedgewood, manager of drawing offices, Sir W. G. Armstrong, Whitworth & Co., Elswich Ship Yard, New Castle-on-Tyne, England; Clarence W. Wiley, superintendent engineer, Boston Tow Boat Co., East Boston, Mass.; Frank Willis Grogan, naval architect, coast and geodetic survey, Crescent Ship Yard, Elizabeth, N. J.; William Strother Smith, passed assistant engineer, U. S. N., Wm. R. Trigg Co., Richmond, Va.; John Lawrence Frisbie, in charge of construction and repair, Lockwood Mfg. Co., Everett, Mass.; William J. Wood, naval architect for Goodrich Transportation Co., Chicago, Ill.; J. Harvard Biles, professor naval architecture, University Glasgow; Jarvis Bonesteel Edson, 313 West 74th Street, New York.

From associate to member: Henry E. Rottmer, draughtsman bureau construction and repair, navy departments, Washington, D. C.; Henry G. Smith, assistant naval constructor, U. S. N., navy yard, Brooklyn, N. Y.; William Henry Deming, mechanical engineer and draughtsman, Continental Iron Works, Brooklyn, N. Y.; Albert Lloyd Hopkins, inspector Newport News company, Newport News, Va.; Axel Gustaff Rossell, chief draughtsman, Wm. Cramp & Sons, Philadelphia;

From junior to member: Sydney L. Wood, draughtsman, superintending constructor's office, U. S. N., Newport News, Va.

Associate: Walter Aucker, superintendent of floating equipment, B. & O. R. R., Camden Station, Baltimore, Md.; George Crouse Cook, ship draughtsman, Wm. Cramp & Sons, Philadelphia, Pa.; Edwin S. Denise, marine department, Deane Steeam Pump Co., New York; William E. Fitzgerald, president Milwaukee Dry Dock Co., Milwaukee, Wis.; Everett G. Haymaker, assistant draughtsman, U. S. N., Bath Iron Works, Bath, Me.; F. D. Herrimann, surveyor general for the Great Lakes Register, Chicago, Ill.; James W. Kellogg, manager marine sales, General Electric Co., Schenectady, N. Y.; John A. Lord, assistant draughtsman, U. S. N., Bath Iron Works, Bath, Me.; Theodore Lucas, calculating draughtsman, Cramps' ship yard, Philadelphia, Pa.; Julius Martin, master electrician, equipment department, navy yard, Brooklyn, N. Y.; Alfred G. Smith, secretary and treasurer, New York & Cuba Mail Steamship Co., New York; Frederick C. Starke, vice president, Milwaukee Dry Dock Co., Milwaukee, Wis.; Arthur P. Allen, marine engine draughtsman, Newport News, Va.; Frederick S. Brinton, draughtsman, Crescent Ship Yard, Elizabeth, N. J.; Wilson Brown, superintendent, Amboy division, P. R. R. Co., Camden, N. J.; Wallace Downey, Townsend & Downey, Brooklyn, N. Y.; Frederick D Owen, draughtsman, bureau construction and repair, navy department, Washington, D. C.; George H. Wilson, draughtsman superintending constructor's office, Columbian Iron Works, Baltimore, Md.

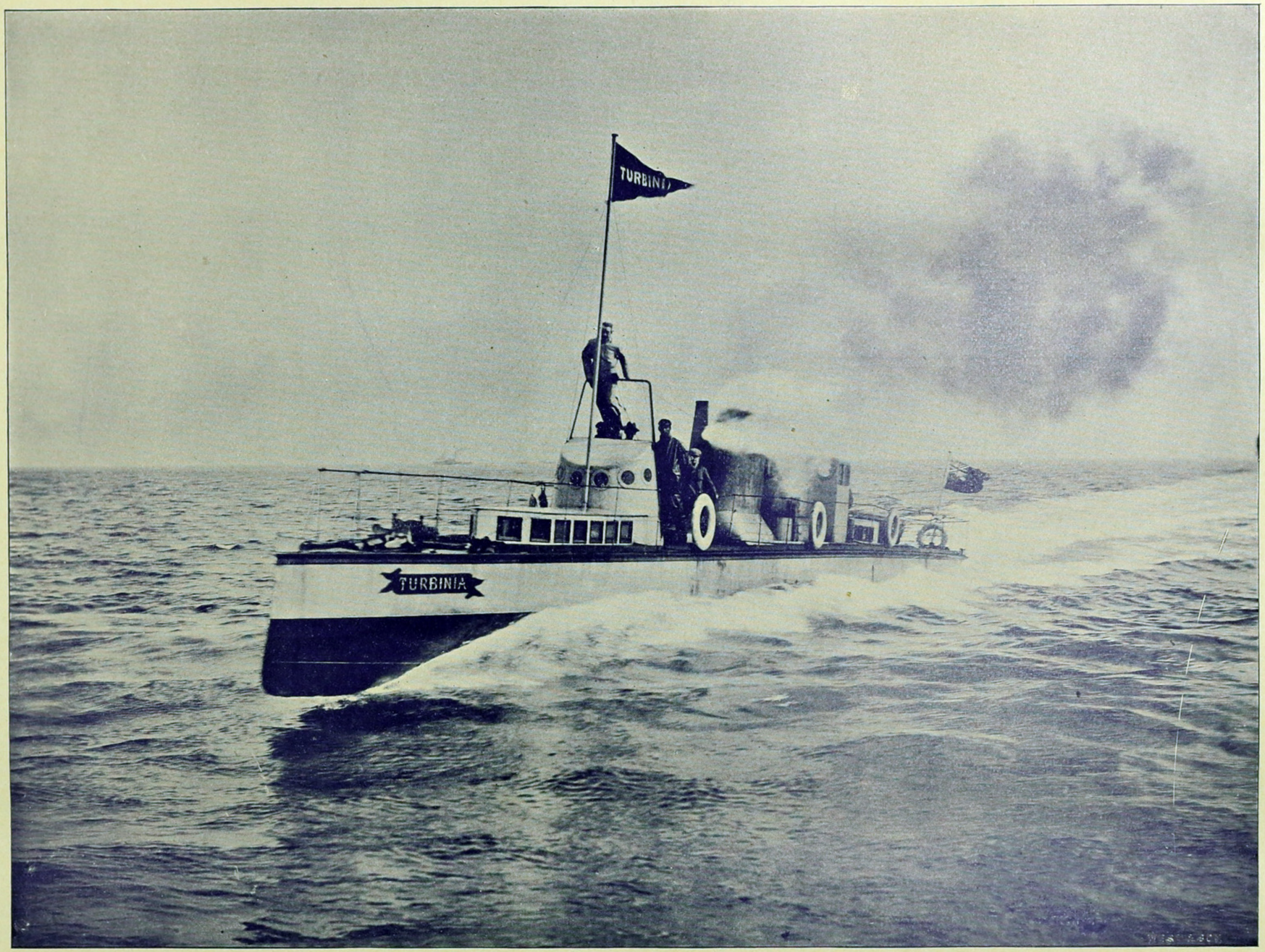
Juniors: Edwin S. Alexander, ship draughtsman, Newport News company, Newport News, Va.; William Binley, assistant draughtsman, U. S. N., Newport News, Va.; Almon F. Bowen, draughtsman, Newport News Co., Newport News, Va.; Dean Clark, engine draughtsman, Newport News, Va.; Ernest I. Cornbrooks, draughtsman, Harlan & Hollingsworth Co., Wilmington, Del.; Thos. M. Cornbrooks, draughtsman, Harlan & Hollingsworth Co., Wilmington, Del.; A. A. Packard, draughtsman, Herreshoff Mfg. Co., Bristol, R. I.; Benjamin C. Fernald, assistant ship draughtsman, U. S. N., Newport News, Va; M. Hobart McGann, draughtsman, Newport News company, Newport News, Va.; Albert L. Swasey, draughtsman, Newport News company, Newport News Va.; Edward J. Tuck, assistant foreman, Bath Iron Works, Bath, Me.; Benj. C. Tuthill, copyist draughtsman, U. S. N., Philadelphia, Pa.; William Willis, engine draughtsman, Newport News, Va.; Fred A. Hunnewell, assistant draughtsman, naval constructor's office, Newport News, Va.; H. L. Meeker, Jr., draughtsman, navy yard, New York; Arthur Willey Chase, assistant draughtsman, U. S. N., Newport News, Va.; Charles P. Paulding, draughtsman, W. D. Forbes Co., Hoboken, N. J.

After reading the list of new members Secretary Bowles stated that the council authorized him to announce their recommendation that the present officers and board of managers be re-elected with the substitution of Mr. G. W. Dickie, superintendent of the Union Iron Works, San Francisco, for Mr. J. F. Pankhurst, deceased. President Griscom relinquished the chair to Dr. C. H. Haswel, during the election. The recommendation of the council was carried unanimously, and upon being called to resume the chair the president delivered his annual address which was well received. Mr. Griscom said:

ADDRESS OF PRESIDENT GRISCOM.

"I accept this further evidence of your good will and confidence with a renewed appreciation of the distinguished honor you have again conferred upon me. The past year has been one of exceptional interest to the members of this society. The laurels won on the decks of the warships built in the shipyards of the United States have electrified the world, and the marvelous victories gained reflect credit which can well be shared by our gallant sailors with the designers and builders of those ships, which they commanded with imperishable honor. The demands made by the government in the war with Spain for colliers, water boats, troop ships, hospital ships, supply vessels, guard boats, blockading vessels, scouts and cruisers largely exceeded the supply found in our merchant marine. The navy purchased about 110 vessels of various classes, and the war department chartered and purchased about 100 important steamships, and these 200 ships, from yacht to transatlantic liner, were fitted out for the purpose of the war with incredible dispatch, and upon the whole in a most effective manner, The vessels so taken or purchased all rendered valuable service to the government and gave sea experience to a large number of men, which we can confidently hope will prove a stimulation to sea employment.

"An enormous public interest has been awakened in the performance of this so-called 'auxiliary navy,' and the practical lesson the country has received from the late war leads me to repeat what I had the honor of saying to you in 1894. On that occasion I said: 'It should be understood that a modern naval force, with all its multitude of equipment, arms, munitions and accessories, cannot be produced on the spur of the moment, but is the product of naval architects, steel-makers, and a host of others whose skill can only be obtained by experience. It must not be overlooked that the personal element in warfare, as in peace, is an all-powerful



THE TURBINIA STEAMING 35 KNOTS PER HOUR.—BUILT BY THE PARSONS STEAM TURBINE CO., ENGLAND.

one, sometimes predominating, sometimes secondary, but always of the greatest importance, and, therefore, an adequate navy is necessary, not only for the actual representation of power and force, but also to secure to our officers and men that superior nautical training only to be obtained by such continued experience at sea as made heroes of Hull, Decatur and Farragut. The full development of a naval force, however, is not possible unless the growth of the merchant marine has kept pace with the naval development. The words of Sir Nathaniel Barnaby—No nation can maintain an efficient navy without a prosperous commercial marine to support it—have still the force of an axiom. It should not be overlooked, that, in time of war, the conversion of fast mail steamers into armed cruisers is generally recognized among all maritime nations as a most formidable means of offence or defence for any country so fortunate as to possess them; moreover, to provide for the expansion of naval personnel rendered necessary in time of war there must be a well trained merchant marine to draw upon, and those nations which have not encouraged shipbuilding and shipowning in times of peace must inevitably suffer from their shortsighted and narrow policy when confronted with a powerful hostile fleet.'

"None of us supposed, when these observations were made, that within four short years this country would be confronted with a foreign war, which has made these remarks almost prophetic, for the lesson has been vividly brought home to us that in order to sustain effectual naval and military operations, not only was the entire merchant marine of the country, suitable for the purpose, enlisted in the national defence, but some fifteen or twenty vessels were purchased which floated the flag of a foreign nation, and these necessary purchases would have been quite impossible if the flag which floated over these ships had not been that of a friendly nation, and the controlling voice in the management of those ships patriotic Americans. Let the country never forget—it cannot too often be repeated—'That no nation can maintain an efficient navy without a prosperous commercial marine to support it.'

"It is not too hopeful to predict that one of the results of the war resulting in the acquisition of distant insular territory, will exercise a marked effect upon our shipbuilding industry; indeed, it may be the turning point from which this nation may commence to regain its once proud position as a shipbuilding, shipowning and seafaring people; and it is very happy testimony to your skill as naval architects and marine engineers that several orders have already come from foreign nations for warships of the first class, and it is well known that foreign shipbuilders and capitalists have commenced seriously to examine with interest the advantages of this country for shipbuilding. Ship steel has been exported to Great Britain this year on its merits as to quality and cost. The commercial products of our ship yards for the past year have not supplied all waste, and besides this demand there are prospects of again building noble vessels for the foreign trade. Our people are more than ever awake to the value of an efficient navy, and at this moment we have in sixteen different ship yards fifty-two vessels of various types building for the United States. Of these eight are battleships, four monitors, and the balance torpedo boat destroyers and torpedo boats, with one training vessel for the naval academy.

"In the short time very properly allowed for such an address as this, it is only possible to make a brief allusion to the most interesting facts that might occur to us, and I am sure we can all unite that these facts promise a gratifying and pleasing field of future activity for our members and involve the solution of many interesting and difficult matters of administration and business, as well as the questions of technical importance, which will tax your highest skill and ingenuity. The report of your council shows the membership of the society is increasing and its finances to be in a very satisfactory condition. As a layman I always address you with diffidence, but I am renewedly impressed with the value of this society to your profession and to the shipbuilding interests of this country, which demand not only fostering care, but alert, intelligent, painstaking study. I am happy to be able to lay before you a program of more than usual interest, and note with satisfaction that the important papers have been submitted to the members at an earlier date than usual. This should add largely to the value of our discussion."

FIRST PAPER—"STANDARD NAVY BOATS."

The first paper called for was that on "Standard Navy Boats" by Arthur B. Cassidy, and in the absence of the author it was read by Naval Constructor John G. Tawresey.

After describing the various small boats in use in the navy, Mr. Cassidy says that the standard boats "are not of an immediate growth, but are the result of experience of many years of actual service, and much time and thought by many men." Tables were presented giving the principal dimensions and weight and least freeboard of the standard boats.

"The practice," the author says, "is to have all frames made of white oak, steamed and bent. In many cases where these frames have been made from flitches, or the natural crook, they have not stood the strain of a sudden shock, have broken from the blast of a gun, or the swinging of the boat against the vessel or wharf. The keels, stem, stem-posts, keelsons, frames, risings, footlings and wash strakes are built of white oak the plank of white cedar, the thwarts of white ash, and the boats are copper-fastened throughout. The hanging bolts are of galvanized iron, and are strongly riveted over washers or plates in the stem, keel, or sternpost. All metal fittings of the boats are of brass. Of the fittings of the boats, the greatest difficulty has been with the detaching apparatus of life-boats. Many kinds have been used, and failures to work at the proper time have been noted. The automatic releasing hook is now being largely used in the navy. By this appliance, the boat is under control from the deck, and is rapidly lowered, and automatically released as soon as the boat touches the water.

"Many of the crews of the old navy took a great deal of pride in their racing cutters, but in the new navy, where everything has to be well considered from many points of view, the racing cutter seems out of place. As the boats are standardized, and those of all vessels are alike, size for size, a boat race would become a question of strength and endurance, and be much more interesting than a race between two boats of unequal form. The element last to be considered in the navy boat is speed. The life of the navy boats is comparatively short, probably averaging ten years. One hundred boats have been built during the past year, and there are now in use in the navy about 1,000 boats of all classes."

Discussion of this paper was opened by Mr. W. P. Stephens who said in part: "This is the first time we have heard anything about boats. There is no doubt but that the boat is oftentimes of more importance than the ship, as in the case of the Mohegan and Bourgogne, for instance. It seems to me that these navy boats are well adapted for their purposes. I judge from those that I have seen under repairs at the navy yard that their construction is good. I was much interested the other day in an inspection of a boat taken from the Spanish cruiser Colon. I am also much interested in the rig of these boats, which seems small to yachtsmen. We have found that in cruising the yawl rig is very effective. I hope that next year we shall hear more about boats." Mr. Tawresey closed the discussion, prefacing his remarks with the explanation that his conclusions were the result of observations while in charge of one of the largest boat shops in the navy. He said that much damage was done to boats by placing them too near the guns on shipboard and that the durability of the boats was frequently seriously impaired by present methods of hoisting them. In answer to questions which had been propounded he stated that folding boats were not looked upon with favor by the department and that in general the experience with metal boats had not been satisfactory. This latter was also true in a measure of the experiments made with an aluminun centerboard. The question of an iron or steel centerboard was, he thought, largely one of weight. Naval Constructor Bowles took occasion to add that the subject of boats was one which had been accorded an enormous amount of study in the navy department. He thought much of the credit for progress in this line was due to Chief Constructor Hichborn.

The paper on "Bilge Keels and Rolling Experiments—U. S. S. Oregon," prepared by assistant naval constructor Lawrence Spear, was read by Prof. W. F. Durand. Mr. Spear explained that original designs of the Oregon and vessels of her class (Indiana and Massachusetts) provided for bilge keels of about 30 inches depth; but during the building of these vessels it was decided to omit the keels to facilitate docking. The value of bilge keels on quick moving ships of small inertia was appreciated, but theoretical considerations led to an underestimation of the extinctive effect of bilge keels of practical dimensions as applied to slow-moving ships of large displacement and inertia. While the Oregon type of vessels were completing, foreign practice underwent a change regarding bilge keels in such ships, and this was what led to the trials that are dealt with in Mr. Spear's paper. He says that although the rolling of these ships was exaggerated, the reports from them, taken in connection with the results obtained, fully justified the fitting of bilge keels for the purpose of obtaining a steadier platform. The main portion of this paper, dealing with rolling experiments with and without the keels, and with the results of these experiments, was somewhat technical and did not admit of a great deal of discussion. Naval Constructor Bowles said he believed that it had been demonstrated that bilge keels are necessary in battleships and that the department would never again venture to build a battleship without them, even were it necessary to build new dry docks to accommodate the vessels. Assistant Naval Constructor, Richard M. Watt suggested that it might interest the members to know that the time required at the Brooklyn navy yard for fitting the battleship Massachusetts with bilge keels was exactly 16½ working days.

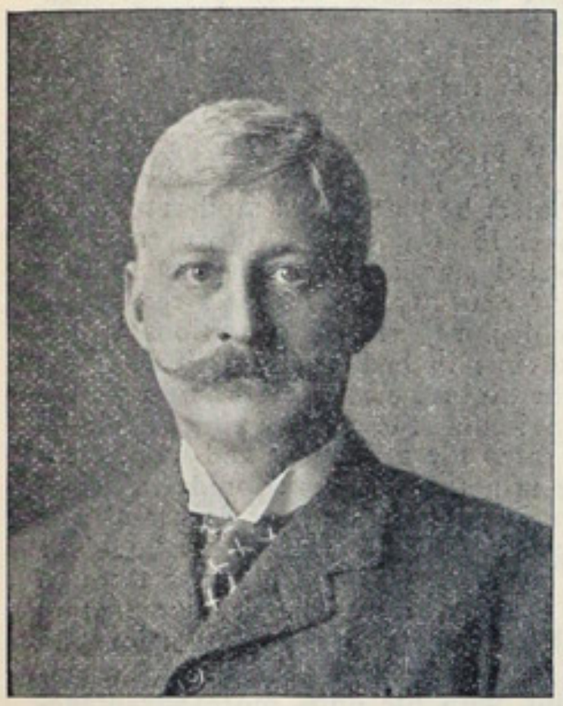
ASS'T NAVAL CONSTRUCTOR SPEAR.

PORTABLE PNEUMATIC RIVETERS.

Nowhere in the world have riveting machines in shipbuilding been used to the extent that they have been used at the works of the Chicago Ship Building Co. Especial interest therefore attached to the paper on "Portable Pneumatic Riveters in Ship Building" by W. I. Babcock, general manager of the Chicago company. Mr. Babcock was present and read the paper himself. He said at the outset that in the Chicago yard they were able to drive every rivet in a ship by power machines operated by unskilled labor, and in the last ship they built over 250,000 rivets were so driven out of 340,000 in the vessel. But that the air capacity of the ship yard was insufficient, the proportion would have been greater. Mr. Babcock has been closely associated with the management of the Chicago Pneumatic Tool Co. in the development of these tools for ship yards. They have been sold in all parts of the world, and the Review has on several occasions printed descriptions and illustrations of the various forms of machine. Mr. Babcock's paper was largely a history of the experience of his company in developing the portable machines since experiments were first made in driving rivets in 1896 with an ordinary pneumatic hammer. He described the various devices and attachments used for different kinds of interior work, for decks and tank tops, for the sides of the ship, for bilges, bottoms, etc. These were all shown in a dozen or more illustrations, most of which have already appeared in these columns. He said that in deck and tank top work three men and a heater boy will drive from 800 to 1000 rivets in a day.

"That these machines can and do make better work than hand riveting," said Mr. Babcock, "is evident from several considerations. It is well known that in hand work constant watchfulness is required to make the men properly 'plug' the rivet before heading over the point; that is, to strike the first blows exactly in line with the axis of the rivet, so as to upset it clear to the head and make it properly fill the holes; it is much easier and quicker for the men to knock the head over at once, and when that is done, as the head and point look all right, there is no way of determining in what condition the body of the rivet is, unless it is loose under test, or loosens up in service afterward with the constant vibration and jar of the ship, as often happens. With the machine, however, it is almost impossible not to plug the rivet, the hammer being very easily

and naturally brought in line with its axis, and, in fact, will not drive the rivet properly unless it is so in line, and the blows of the hammer being so rapid that the plugging is accomplished before the point is formed. The whole operation of driving the rivet is completed much more quickly than by hand, and before the rivet has lost its heat, the resulting contraction afterwards drawing everything firmly together as the rivet gets cold, and strengthening the joint by the well-known effect of the friction between its parts. Again, there are very many places in the framework of a ship where there is not sufficient space for swinging a hand hammer in driving a rivet, or where the rivet can be gotten at from only one side. Such rivets as those through beam knees and frames, in the conections of floors to center keelsons, wash plates between floors, frame brackets at tank tops and decks, in cellular tanks, and generally wherever the available space is only that of the frame spacing, or less, or where a rivet comes in the bosom of an angle or channel, are of this type, and are among those most important to be well driven, the integrity of the framework depending largely upon them. From the nature of the case, hand-driven rivets in such situations are not what they should be, but it is evident that such considerations do not affect the machine in the slightest degree, and that if the hammer can get onto the rivet at all it will drive it as well in such locations as in the most open parts of the work.



MR. W. I. BABCOCK.

"As for the quality of the work done by these various methods of power riveting, I can say that the unanimous opinion of the hull inspectors who have been on duty in our yard for two years and more is that the rivets are first-class in every respect, and make far better and tighter work than those driven by hand. As for the cost, I will say that, adding cost of air, repairs, etc., the saving is from one to two cents per rivet over piece-work, prices for hand riveting, depending upon the location in the ship and averaging about 1¼ cents. In an ordinary lake steamer of 4,000 tons the saving is from $4,000 to $5,000 over handwork. A further, and very important, advantage, however, is in the fact that skilled labor in one of the principal departments in a ship yard, which has hitherto been indispensable and correspondingly arrogant and high-handed, can be replaced by unskilled labor. The quality of the work done by portable pneumatic riveters in ship building is such that the various classification societies cannot ignore it, and before very long will doubtless recommend, if not require, that all rivets in at least the principal portions of the ship be driven by power."

General Manager R. L. Newman, of the Globe Iron Works Co., Cleveland, opened discussion of Mr. Babcock's paper by stating that he had, as long as two years and six months ago, worked pneumatic riveters on tanks with success, and that eminent satisfaction had also been given by the work done by pneumatic machines on the revenue cutters recently built by the Globe company for the United States government. Mr. Newman adding that he thought the revenue cutter service officials were, in their inspection of such work, if anything even more particular than their naval brethren. Mr. John Platt was the next speaker on the subject. Said he: "It seems strange to one who has had connection with the English yards for ten or fifteen years to find people taking up riveting by hammer instead of by means of the steady pressure considered so necessary by ship builders abroad. I am under the impression that for the heaviest class of work the pneumatic riveting would not prove satisfactory. At the yard of Harland & Wolff at Belfast, Ireland, an immense gantry spans the whole ship under construction and carries the riveters on special cranes, which themselves travel up and down and bring to bear a pressure of from 40 to 50 tons on the rivet. This plant was especially designed for work on the White Star liner Oceanic, now under construction at the Belfast yard. The ship builders in England and Ireland have taken up hydraulic riveting, but this is the only form with which they have had experience. I believe plants of this type have also been installed in Russian yards. Great difficulty was at first experienced from the freezing of the water, but this has been remedied, I believe, by the use of a composition consisting of one-third crude glycerine and two-thirds water. I believe there is an impression in this country that the plant at the yard of Harland & Wolff is not economical and that the firm is dissatisfied. This would seem to be refuted by the fact that the firm has just ordered a duplicate plant for smaller work."

Naval Constructor Tawresey said that his experience with pneumatic riveters was that they performed the work economically, rapidly and thoroughly. Mr. L. R. Pomeroy of the Cambria Steel Co. inquired as to the limitations of pneumatic riveting and as to whether any difficulty from leakage developed which was not experienced in hydraulic riveting.

In closing the discussion Mr. Babcock said: "In answer to a question by Mr. Platt, I would say that one inch is the largest size of rivet which we have driven in our yard, but I am informed that the same size hammer in operation in bridge shops has driven 1¼-inch rivets without any trouble. I do not believe that the quality of the work can be called in question in any event. The problem of larger work is simply a question of making the hammer large. There is no reason why rivets up to 2 inches should not be driven satisfactorily. The reason why I favor pneumatic over hydraulic riveters is that the former may be manipulated by hand. The gantry crane is an extremely expensive construction. The derricks used in such work are so slow as to be of little use and we do the same work with a riveter which two men can carry. As to the question of limitations of the work, I would simply say that there are no limitations. A 10 or 12-foot gap may be made just as easily as a 4-foot gap. Now, with regard to a question from Mr. Newman about shell riveting, I may say that in one comparison which I made we drove 51,306 shell rivets by hand at an average cost of 3.99 cents each, whereas by the use of the pneumatic riveters we drove 74,493 shell rivets at an average cost of 2.96 cents each. The figures given are, be it understood, the direct cost. The cost of repairs, etc., is not included."

TORPEDO BOATS AND DESTROYERS.

SECOND SESSION LARGELY TAKEN UP WITH A DISCUSSION REGARDING VESSELS OF THIS KIND--EXCELLENT PAPER BY MR. F. M. WHEELER.

The afternoon session on Thursday, Nov. 10, opened with Edwin A. Stevens in the chair. The first paper was an addition to the prearranged program, in the form of a discourse on submarine boats, illustrated with stereopticon views by Capt. W. H. Jacques. Capt. Jacques' paper will be found in full elsewhere in this issue, as will also the paper on "Torpedo Boat Destroyers for Sea Service, with Special Reference to the Conditions that Prevail on the Pacific Coast," by Mr. G. W. Dickie, the reading of which by Secretary Bowles followed immediately. The discussion was opened by the reading by Mr. Bowles of a number of communications from naval officers unable to be present, on the subject of either the Dickie paper or the question for topical discussion—"The Utility of Torpedo Boats and Has the Submarine Boat a Place?"—the consideration of which it was decided should be made simultaneously with that of the Dickie and Jacques' papers.

Mr. John Platt took issue with Mr. Dickie in a rather extended argument. In part he said: "I take exception to the way in which Mr. Dickie has treated this subject. I fully believe that he has made a classification of a vessel in a wrong school. The boat which he has described could much better be classed as a torpedo cruiser or torpedo gunboat, rather than a torpedo boat destroyer. From what Mr. Dickie says I feel very certain such a boat should be built. If I mistake not, the United States government had plans drawn for such a boat some time ago but unfortunately it was not built. To take up another portion of his paper I may say that I made runs last year on a standard 390-ton English destroyer. On the first day it was in a very heavy sea—so heavy indeed that it was found impossible to complete the run. However, she made 27 knots against the wind, and 32 knots when running before it, and this was maintained for three hours. I have been on this boat a number of times and no difficulty was experienced in maintaining 30 knots at all times. It is not true that in the English destroyers everything has been sacrificed to speed, and moreover three hours is not a short run. In English practice considerations other than speed are taken into account. Mr. Dickie says that the destroyers lately ordered by the government are an improvement. On the lines he discusses undoubtedly they are, but it is to be doubted if as torpedo boat destroyers pure and simple they are any improvement whatever. A boat such as he describes is practically the same as the Speedy, one of the first torpedo gunboats made on the other side. She ran her trials under actual service conditions and developed 5,000 horse power easily."

Mr. R. L. Newman was the next to contribute to the discussion and in the course of his remarks he said: "Structurally torpedo boat destroyers are very strong as the material is at present distributed. I presume that after we get out of our present throes of experiment we will get better results. Mr. Yarrow told me when he was in this country that he was surprised at the low prices at which our builders took boats, especially in view of the fact that the torpedo boat destroyer must be considered a delicate machine."

At this point Mr. Stephenson Taylor took the chair and the discussion was continued by Mr. W. P. Stephens, who said: "It seems to me that the boat described by Mr. Dickie ought to prove a very useful vessel. The vessel outlined is practical and in the main better than any of the auxiliary yachts. It would cost no more than the Gloucester and be more efficient, and while costing only half as much as the Mayflower prove far more valuable."

Assistant Naval Constructor Richard M. Watt said in the course of remarks on this topic: "To my mind the Morris is the ideal torpedo boat. I had charge of repairing eleven torpedo boats at the Brooklyn navy yard, and from my observations in that connection I would have no boats except of the Morris type, and from these advance one step to the 400 or 500-ton torpedo boat destroyer, cruiser or gunboat, which ought to also serve as a dispatch boat. During the recent war the fleet was, on occasions, obliged to keep the sea for hours while a torpedo boat ran into some harbor—a service for which such a boat as that described would be ideal." Mr. C. D. Mosher, naval architect, said: "Replying to certain questions which have been raised, I must say that I believe there is plenty of ability in the country to develop men capable of handling the finest type of boat, and the navy department could undoubtedly school a personnel to give complete satisfaction. With regard to size I think there should be a broad line between harbor boats and destroyers. In one class I would place 100-ton boats of 35 or 40 knots and in the other larger boats of slower speed. I am confident that a partially protected torpedo boat destroyer with a superstructure for fighting purposes is practicable and that a satisfactory sea boat can be developed along these lines."

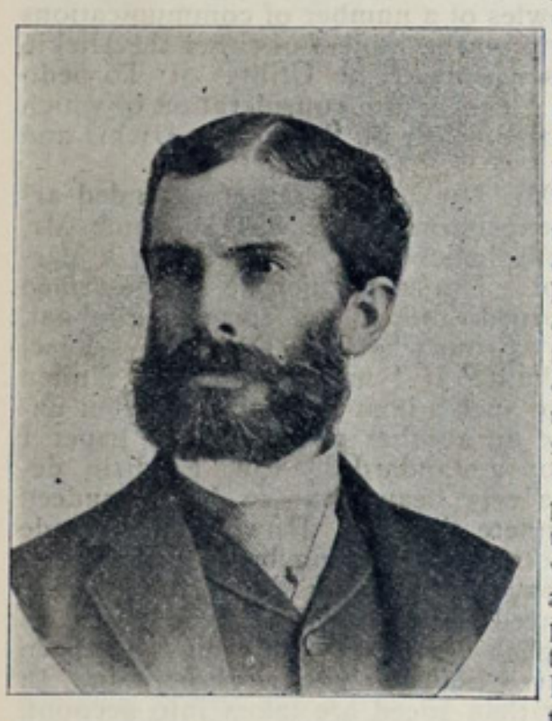
Naval Constructor Tawresey has the reputation among his brother officers of being a non-believer in torpedo boats and for this reason his remarks were listened to with especial interest. In the course of a few minutes' talk he said: "I would like to ask the advocates of torpedo boats and destroyers what they want them for? I do not think that the experience of all torpedo attacks in the past justifies an expectation of much from the torpedo. It seems to me that the wave motion of a boat moving at good speed is the best possible torpedo net. The torpedo boats are to be credited with valuable service during the war, but they were utilized for purposes for which they were not intended."

Mr. John C. Kafer, superintendent of the Morgan Iron Works, N. Y., said that many of the torpedo boats are built with the idea of a favorable showing on a trial trip, rather than in actual service. In answer to certain statements about water tube boilers brought out in the general discussion, Mr. F. L. DeBosque was very emphatic in declaring that injury in water tube boilers in torpedo boats was almost invariably due to neglect. He had considerable experience with water tube boilers—four

types—and all of them are now in operation from 16 to 18 hours daily. Mr. Stephenson Taylor also thought it unfair to condemn the boilers or to say that they were built with reference to the requirements of the trial trip only, whereas many of the English destroyers had made runs of several hours duration. He was inclined to think that the fault was with the personnel. Naval Constructor Bowles had an apologetic word for the personnel. He incidentally remarked that frequently during the late war the torpedo boats exceeded the limit of their fresh water endurance and were obliged to use salt water in the boilers.

ECONOMY TEST OF A UNIQUE FORM OF FEED PUMP.

At the conclusion of the discussion regarding torpedo boats, Mr. F. M. Wheeler of the Geo. F. Blake Mnfg. Co., a concern that has equipped a great number of our naval vessels with pumps, read a paper on "Steam Economy Test of a Unique Form of Feed Pump." In full-power trials of United States war ships it has been found that the average indicated horse power developed by main feed pumps is about one-half of one per cent of the I. H. P. of the main engines. In view of the great desire for economy in auxiliaries of all kinds, the feed pump is of special importance. The steam consumption of a feed pump of the duplex type (the one most commonly in use in the vessels of the United States navy) will average about 120 pounds weight of steam per I. H. P. per hour. In the tests made on the United States cruiser Minneapolis, the very best economy shown in the case of the main feed pumps was a little over 93 pounds, while the poorest showing (when one of the main feed pumps was supplying the donkey boiler, and consequently running at an abnormally low rate of speed), was over 200 pounds per I. H. P. per hour. The particular pump to which Mr. Wheeler's paper referred—a pair of Blake "simplex" vertical double-acting steam pumps arranged on the cross-compound plan—did its work with an expenditure of only 52 pounds of steam per I. H. P. per hour. In other words, this special form of pump uses considerably less than one-half the steam required ordinarily by a duplex pump of the simple type. The test was conducted by experts connected with the engineering department at the engine works of Messrs. Willans & Robinson at Rugby, England, and was for the benefit of the British admiralty. The paper contained a complete description of the pump with illustrations and also full particulars of the test.



MR. F. W. WHEELER.

"Taking the case of a large transatlantic steamer developing 30,000 I. H. P.," said Mr. Wheeler in conclusion, "which I understand will be the engine power of the new White Star steamer Oceanic now building, the amount of coal that could be saved on a trip (say of 5½ days) would be about 77 tons by the use of a system of feed pumps of this cross-compound "simplex" type, as compared with the duplex system; or, a saving of about 44 tons of coal as compared with the single system of feed pump. This saving in coal not only represents an expenditure of many dollars, but also considerable saving of space which could be made available for cargo or other purposes affording a revenue, thus not only saving money at one end but adding at the other end. Much has been done during the present decade to improve the economy of the steam engines, and some remarkable results have been secured, but very little, however, has been accomplished in the line of steam economy in the auxiliaries, such as steam pumps. There is every reason, therefore, why refinements in this line should be encouraged."

In the course of discussion of this paper, which was short but quite complimentary to Mr. Wheeler, Passed-Assistant Engineer McFarland of the navy bureau of steam engineering said that in the preliminary naval program mapped out for presentation to the next congress it was proposed to provide for the equipment of all the new battleships and cruisers with water tube boilers at a pressure of 300 pounds and he thought it would be interesting to see how the pump manufacturers would meet this high pressure.

YACHTS AS AUXILIARIES.

MR. WILLIAM P. STEPHENS' PAPER ON THIS SUBJECT AND THE DISCUSSION FOLLOWING IT TAKE UP THE GREATER PART OF THE THIRD SESSION.

There was a perceptible increase in the attendance at the opening session on Friday morning, Nov. 11, at which Mr. Stephenson Taylor presided. The members first listened to the reading by Mr. William P. Stephens on "The Steam Yacht as a Naval Auxiliary."

Mr. Stephens opened his paper with a resume at some length of the conditions which necessitated the utilization of steam yachts for service in the auxiliary fleet of the United States navy during the recent war, following this with details as to the character and extent of the alterations made. Of exceptional value was the table which he appended giving the dimensions and full details of all the steam yachts converted to the government use. Summing up what he terms "an experiment arising from an emergency which should never have occurred," he finds that the merits of the fleet of these vessels were not put to a practical test. He further declared that "the possibilities of the yacht fleet at the present time for conversion to war uses were, even from a theoretic standpoint, far from promising.

"Many of the vessels were ill-fitted in model for real service at sea; there was a lack of displacement for the added weights of armament and ammunition, of berthing space for crew, of bunker space, and suitable locations for magazines. The nominal speed, in many cases low in itself, was not realized even in smooth water, and in a sea there was a serious loss of the average working speed. There was no protection, no distilling apparatus; the capacity of the water tanks was generally inadequate, and the decks were not designed to withstand the shock of the guns. The draught as a rule was greater than was necessary or desirable. The nature and extent of these defects were fully realized at the outset, but under the circumstances there was no other course but to take the yachts as they were and to make the best of them. All things considered, they have done their work quite as well as was to be expected."

The author took up and discussed quite fully the suggestion for some scheme of co-operation between the government and individual yacht owners but is apparently far from sanguine of the success of any such plan. He declared, however, that it is obviously to the interest of the government to encourage the building and use of yachts. The statement was also made that the yachts are capable of a work not properly within the province of either the gunboat, destroyer or torpedo boat. The former is too large, while the two latter classes have limitations which prevent their utilization in all the contingencies that might arise.

Mr. Stephens concluded as follows: "The work of the yachts, their success and failures taken together, with the work of other small craft such as tugs, light-house tenders, etc., impressed into the same service, seems to indicate the desirability of the creation of a new type of small auxiliary not at present recognized on the navy list. The controlling feature of design—the speed—may at the outset be placed at a moderate figure for this era of increasing speeds, not over 18 knots. This, however, is not to be measured by the conventional yacht standard by which an 18-knot steam yacht takes the wash of a good 12-knot tug, but means a reasonable approach to the designed speed under ordinary service conditions at sea, and the ability to keep with the fleet even in bad weather. The model should possess sea-going qualities of the highest class; the draught should be limited to 11 or even 10 feet as a maximum; the construction should be durable, with ample scantling both to carry the armament and to insure a long life with ordinary care in laying up; the engines should be strong and reliable, the bunker space as large as possible, and, as deck and side protection will probably be impracticable, especial attention should be given to the water line protection of machinery and magazines through their location and the disposition of the bunkers. The accommodation should include healthy and comfortable quarters for a proportionately large complement of officers and crew for an indefinite time, and the armament should be comparatively powerful, with the guns more advantageously located than is possible on a yacht. Special provision should be made for magazines, ammunition hoists, distilling apparatus, and minor auxiliaries. There should be no sails, and no spars except the single military mast, and in all cases torpedo tubes should be excluded. Profiting by one serious defect of the yachts, special attention should be directed to the disposition of space in holds and bunkers so that it may be utilized to advantage without a material change of trim.

"The intended uses of this class call for three sizes—for sea work, as dispatch boats and tenders, and for picket duty, vessels of not over 800 tons displacement, about the size of the Gloucester and Scorpion, the draught not exceeding 11 feet in a single screw boat; twin screw boats of this size with draught reduced to 9 feet would be very serviceable, as proved in the present case, for harbor and river work. The next size to be of about 400 tons displacement, about the size of the Hist, Eagle and Hornet, twin-screw vessels of 7 to 8 feet draught, intended for sea service as pickets. The third size, for harbor patrol service, to be of about 200 tons and 6 feet draught, designed for smooth water, carrying a light armament and limited supply of coal. A speed of 15 knots would suffice for this service, but they should be capable of towing a vessel out of possible danger.

"The requirements here set forth are in a general way but the theoretic qualities of the converted yacht, not fully realized now in any one vessel, but easily obtained in a special design. To the specialist in torpedo boat design or to the yacht designer, the problem would be a simple one. On the one hand the demand for very high speed, approaching 30 knots, with its egg-shell construction and numerous limitations, is entirely eliminated; and on the other, the numerous and conflicting requirements of the private owner as to amount and disposition of space are replaced by fewer and simpler ones. A vessel of this type could be built for far less than either the torpedo boat or the converted yacht; she would fulfill her own special mission, covering a very wide range of usefulness, better than either; she could be handled to advantage by the average crew, not necessarily experienced men; she could, when not needed, be laid up for an indefinite time, ready for service at a few days' notice; and when thus laid up she would not be subject to the double deterioration of the torpedo boat; physical in the actual disintegration of her light frames and plating, and technical in the outbuilding by vessels of newer design and higher speed. As practice vessels for the naval militia for short intervals in the summer, a purpose for which it has been suggested yachts might be borrowed; these vessels would be superior to either the yacht or the torpedo boat. They would carry a larger number of men than the torpedo boat, their armament of 4-inch, 5-inch and 6-pounder rapid-fire guns would be better suited for practice than the two extremes of the torpedo and the 1-pounder; and while the larger sizes would be capable of practice cruises at sea, the smaller with their limited draught would be well adapted for such work as the exploration and study of local waters, as now carried on by the naval militia.

"With suitable designs once completed for each size of vessel in the class, there would be no necessity to modify them with each new improvement that gives speed; and the attention of the designer might be concentrated upon the perfecting of details and such a reduction of engines and other parts to established standards as would minimize the cost of construction, and also make it possible to add to the class very quickly in the case of an emergency.

"An examination of the smaller types of gunboats in use by other nations would disclose many interesting points; but it is not necessary to go outside the immediate experiences of the past six months for several important conclusions. The conditions of coast defense, as thus indicated, involve certain work which is not within the legitimate field of the existing gunboat class, or of the high speed torpedo boat; and which can only be done imperfectly and at great expense by means of the conversion of the steam yacht. A special class of vessel fully fitted for this work can be constructed at a comparatively moderate cost; and, once provided in sufficient numbers, can be laid up for an indefinite time in a condition for almost immediate use."

LIVELY DISCUSSION OF AUXILIARIES.

Capt. Jacob W. Miller of the naval militia opened the discussion. Said he: "It must be remembered in speaking of the lessons of the past war that we were fighting a nation which did not draw forth any second line of defense. We must be prepared to fight a stronger nation. The yachts, however, did not fulfill the need of a second line of defense. I had command of several yachts, and I know that the pick of the yachts of the United States were taken for this auxiliary work so that when we are discussing these boats we are considering the best of their class on the sea coast. The speeds of the better class of yachts—those rated at 16 or 17 knots—were not maintained, and on 24-hour runs about the best we were able to get out of them was 10 knots. Some of the firing force were, of course, inexperienced, but there was not berthing space sufficient to keep men fit for work for a week. In short the yachts were'nt rough and ready enough for harbor work. Such an auxiliary fleet must not only afford protection to the mines but must protect and foster commerce, which means the keeping open of a narrow channel through the mine fields. The yachts, in short, must be leaders, helpers and aids to navigation. The vessels employed were not fit for that work. They were too tender and the coal supply of most of them was not sufficient. One of the main faults, moreover, was found in the fact that there was not room for a 24-hour crew and the best work could not be gotten out of the men. I differ from Mr. Stephens on the advisability of having three classes. I think two quite sufficient. You cannot divide the river and bay work from the immediate outside work along the coast and with a little additional expense it will be possible to make a vessel suitable for both."

Naval Constructor John G. Tawresey: "We felt the demand for small vessels to serve as eyes to the navy. To avoid any misunderstanding, I will say at the outset that there was not a single boat bought because the auxiliary board thought her suitable for auxiliary work. We had to avail ourselves of what there was at hand. As a fighting vessel every one was a makeshift. I was impressed with the fact that the vessels as a whole were veritable tinder boxes. The exigencies of the service caused many boats purchased for one use—inside work for instance—to be assigned to other uses. We were also limited as to the amount of money available. However, notwithstanding all these drawbacks, the vessels have done excellent work and have shown an efficiency none of us could have expected. We cannot improvise a navy from yachts and tug boats. No one can doubt that if one of these vessels had been struck by a shell it would have been ignited or capsized quite as quickly as the Spanish destroyers."

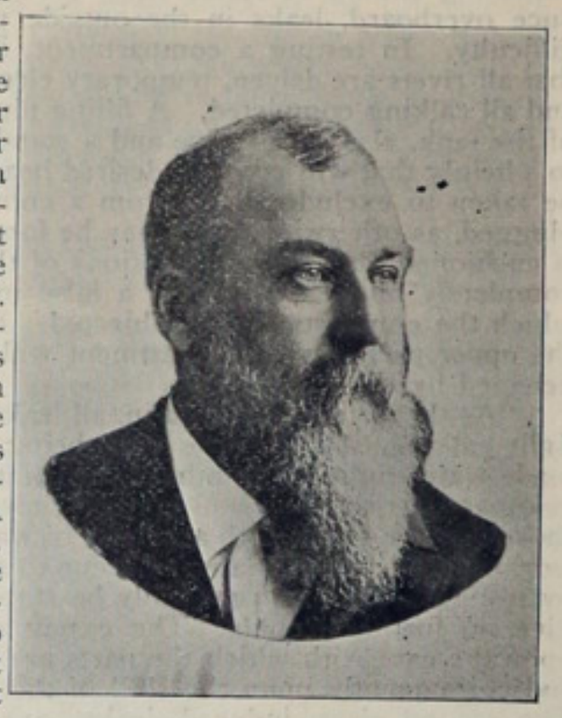
Mr. John Platt said: "I would like to once more emphasize my belief in the fast gunboat. They are not built here but all other nations are building them and building them very successfully." He advocated a speed for these vessels of about 22 knots but with this latter contention Naval Constructor Bowles, who followed him, was not at all in sympathy "We do not want torpedo boat speeds for this purpose," said he. "I think 16 knots quite sufficient. With regard to the speed of the yachts, I must say that some of them did substantial service. The record of the Eagle, for instance, was remarkable. I should object to having but one class or size of vessels for this service. It would be a great convenience to have one class of vessels for the common purpose."

Lieut. William P. White, U. S. N., of the battleship Indiana and who during the war was on the cruiser Minneapolis was the next speaker. In the course of his remarks he said: "For in shore work the seagoing tug is probably sufficient. I think that we will always have to depend in case of war on improvised vessels, inasmuch as it stands to reason that we cannot afford vessels designed especially for this work. The outside work could be done by vessels that could keep the sea for twenty or thirty days at a speed of 12 knots. For this work the most suitable craft would be merchant vessels such as the Yosemite. The Yosemite was during the war just as efficient a scout as the Minneapolis, and I know her steaming radius was greater than ours on the Minneapolis. The 'eyes of the fleet' are not intended for fighting purposes and are not supposed to fight except when it is absolutely necessary. The work of the Yale and Harvard was as good of the Columbia and Minneapolis, and as for our ability to overtake them by reason of our superior speed, I had my doubts. I think one great fault of the auxiliary vessels was found in their lack of trained crews. At present the peace footing on all our vessels must be increased in time of war, whereas it should be in excess in time of peace in order that the men may be available in time of war for service on auxiliary vessels. What we need more than anything else is additions to the personnel. We can do far better, taking makeshift vessels and putting in trained crews than by taking good vessels and putting in makeshift crews. The naval militia in its present form should not be considered at all. The men in the naval militia should be distributed among trained crews and should not be put by themselves under their own officers. Indeed, their own officers admit that they do better under regular naval officers."

Mr. Irving Cox, the well known designer of yachts, came forward with a vigorous defense of that type of craft. He said he had made cruises of 6,000 or 7,000 miles without the least trouble being experienced in the very same yachts which after their conversion to the auxiliary fleet were made the subject of complaint. He further stated that he had investigated a number of these reports and in each case found that the men in charge were inexperienced. Mr. R. L. Newman thought that the present growth of the mercantile marine and the attendant increase in the number of sea going tugs could be depended upon to provide adequate boats for auxiliary work and he expressed the opinion that it would certainly be unwise to contemplate a new type of boat for harbor work. Mr. Stephens in closing the discussion still adhered to his advocacy of the three classes of vessels: First, the torpedo gunboat of the type outlined by Mr. Dickie and designed to keep the sea with the fleet, which is represented at present by the Gloucester; second, the vessel of less draught for coast patrol duty at sea, and third, the converted tugs for harbor work. In conection with certain criticisms which had been made, he suggested slower boats and simpler engines so that they might be manned by the naval militia.

CHIEF NAVAL CONSTRUCTOR HICHBORN'S PAPER.

Owing to the lateness of the hour Secretary Bowles presented the paper on "Designs of the New Vessels for the U. S. Navy" by Chief Constructor Philip Hichborn by simply reading the first paragraph. The value of this paper was in the fact that there were attached to it complete plans of the battleships, monitors, destroyers and torpedo boats, for which contracts were recently let to ship builders in various parts of the country. Particulars regarding each design were arranged in the form of an appendix. In this way Constructor Hichborn again contributes to the proceedings of the society a paper that will prove highly valuable for reference. He calls attention to a few features of special interest connected with the different ships, but the paper otherwise is of value mainly as a part of the proceedings. Mr. Bowles suggested that in connection with the discussion of this paper, consideration be also given to the question of whether the monitors are of sufficient usefulness to justify a continuance of the construction of vessels of this type. A lively discussion resulted. Lieut. White, the first speaker, took the ground that the things of paramount importance in a battleship are coal supply and endurance at sea. He advocated a curtailment of the space given to the captain's quarters or a removal of the same to the deck. He condemned the monitors with the assertion that they were intended for harbor defense, not sea service; that they cannot make speed at sea and that as floating forts they are decidedly expensive to build and maintain. Capt. William C. Wise, late of the Yale, said: "I have the reputation of being a great monitor man. I think that the Puritan is the strongest fighting boat we have in the navy today and I would not hesitate to try her at sea at any time. I think we ought to have at least twenty monitors." Prof. Cecil Peabody advocated standardization for the new torpedo boats and destroyers, and Naval Constructor J. J. Woodward took up the protective deck question and called attention to the fact that the English and French have been providing their vessels with two protective decks for years past.



CHIEF CONSTRUCTOR HICHBORN.

THE CLOSING SESSION.

PAPERS DEALING WITH METHODS OF SECURING WATERTIGHT WORK AND WITH A 150-TON REVOLVING DERRICK—TOPICAL DISCUSSION.

Mr. Clement A. Griscom again presided at the afternoon session on Friday, the 11th, which opened with the reading of the papers on "Methods of Securing Watertight Work" by Assistant Naval Constructor H. G. Smith, U. S. N., and "Tests of the Strength of a Longitudinal Bulkhead Separating Two Engine Rooms" by Naval Constructor J. J. Woodward, U. S. N., it having been decided that a common discussion should cover the two subjects. Mr. Smith first read his treatise. The Review hopes to print at some future date the paper of Naval Constructor Woodward for which space cannot be found at present.

Mr. Smith's paper is a treatise on a subject with which the author is manifestly thoroughly conversant. It embodies detailed data regarding experiments, numerous illustrations and other information that will prove invaluable for purposes of reference. The paper opens as follows: "Specifications for warships require that 'all water-tight compartments shall be tested with water, under a head, as may be directed.' For cofferdams this head is specified, in large ships, to be 5 feet above the load water line, and in most cases, for other compartments, is left to the discretion of the inspection officer. No hard and fast rule can be laid down as to the head of water a given compartment should be made to withstand, but in general those at the ends of a ship, where the pitching motion may materially alter the immersion, and the double bottom compartments which may be required to carry water for a considerable period of time, and both of which are all-important in preserving the safety of the ship in case of injury to the outer hull, should be subjected to a much more rigid test than other parts of the ship. A head of 24 feet of salt water, the load draught of the U. S. S. Iowa and the Indiana class, is equivalent to a pressure of 10.7 pounds per square inch, and 5 feet above this to nearly 13 pounds per square inch, each additional foot of head adding .45 pounds pressure per square inch. When we consider that certain very important parts of the modern ship, such as the floor plates, longitudinals, inner bottom and the lower parts of bulkheads, may, in case of injury, be subjected to a water pressure equal, or nearly equal, to the steam pressure allowed in box boilers but a few years ago, the necessity of making these parts of considerable stiffness, to withstand this pressure, is readily understood. In the case of merchant ships, where the reduction in weight of material put into the hull is not all-important, the required stiffness is easily attained, but in warships, where any addition to the weight of hull means a sacrifice in the fighting qualities, in the coal endurance, or other important features, the problem becomes a serious one, and as a result the scantlings are cut to the lowest possible figure, often so low as to dangerously affect the stiffness.

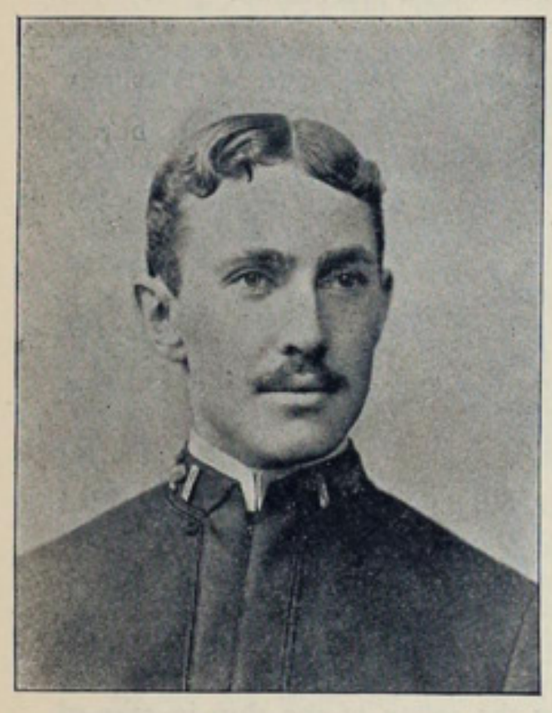
"It is not the intention to discuss the structural strength of the ship in any way, except as it may be connected with the stiffness of the same, the latter term being taken to apply to the local strength of any part, referring particularly to its ability to withstand water pressure. Without impairing the structural strength, the question, then, is what arrangement of material to make that will give the greatest stiffness on a minimum of weight. This arrangement must be largely determined by actual tests of the material under pressure, theoretical results being unreliable unless accompanied by the above. It is the actual results of my experience in testing the Brooklyn, Iowa and Alabama that I wish to place before the society.

"When practicable all water-tight compartments should be tested. As a rule, all compartments below the berth deck, except the engine and boiler rooms, can be tested without difficulty. Furthermore, one of the latter should be tested as a sample to ascertain the stiffness of the main transverse and of the center-line bulkheads. All compartments bounded in any way by such portions of the outside plating as will be submerged after

launching should be tested while the ship is still on the ways, for, when once overboard, leaks in the outside plating can only be stopped with difficulty. In testing a compartment, it should be first examined to see that all rivets are driven, temporary electric light and other holes plugged, and all calking completed. A filling pipe is fitted to some convenient part of the tank, also an air pipe and a stand pipe at the top, the last reaching to a height that will give the desired head of water. Too great care cannot be taken to exclude all air from a compartment before the air escape is plugged, as otherwise water may be forced out of the stand pipe as the air is cushioned, due to the pulsations of the filling pump, before the tank is completely filled, thus giving a false indication of the actual pressure to which the compartment is subjected. Furthermore, leaks that develop in the upper part of the compartment will now be air leaks and can only be detected by the sound.

"As the water is pumped in, all leaks are stopped, as far as possible, by light calking, the pressure only being applied after the compartment is made water-tight under a head due to its own weight. The leaks that develop are of two kinds and may be classed as follows: First, initial leaks—those that are found with any head of water and which are due to imperfect workmanship. These always occur to some extent and can only be found by testing. They can generally be stopped, and when once under control give no further trouble. The extent of these leaks depends principally upon the care with which the parts are fitted together, riveted and calked, and consequently upon the skill of the workmen employed upon the job. The second class, induced leaks, are those that occur only with a considerable head of water, caused by a deflection of the material, with consequent breaking of the calking and opening of the water-tight joints. These depend upon the stiffness of the material, and while they may not occur with one head of water, they may quickly appear as the pressure is increased. They are then to be guarded against, by so designing the parts of the ship as to make them able to withstand specified pressures of water. There are thus two distinct tests made, the first a test of the workmanship, the second a test of the efficiency of the design.

"It is a question as to how far one should proceed in testing a given class of compartments. Where there are several similar ones, such as cofferdams, to be tested to a height of 5 feet above the load water line, and it is found that a particular compartment is able to stand the prescribed test without serious leakage, but with considerable deflection and consequent straining of the material, it is certainly undesirable to test all of these cofferdams to this high pressure when it is known that they can withstand the test in case of necessity. All that is required of the remaining ones is a test for water-tightness, not for stiffness, so that with the exception of a few sample cases, a pressure head equivalent to the height of the load water line is quite sufficient. The same is true of other similar compartments. It is an impossibility to make all compartments absolutely water-tight; they can only be made practically so, and when a certain degree of perfection is reached it is a waste of time and labor to proceed further. However, in order to secure practical water-tightness, it is necessary to demand absolute water-tightness, discretion being left to the inspection officer to say when a test is satisfactory. A slight weeping of rivets or joints is immaterial, and more damage is often done in trying to repair them than by leaving them as they are. All compartments that are unsatisfactory at the first test should be refilled after having been stiffened, if necessary, and thoroughly recalked throughout.



ASS'T NAVAL CONSTRUCTOR H. G. SMITH.

"Specifications require that all material should be calked metal to metal, where possible. This is done either by hand or by pneumatic tools, and, when carefully done, I have been unable to detect any difference in the character of the work in the two cases as far as water-tightness is concerned. The custom of chipping the edge of an angle bar before calking appears to be unnecessary. Equally good results were obtained on the Alabama, where the bars were chipped and calked and where simply split and calked. There are many cases where it is necessary to adopt other means than calking for securing water-tight work. Some joints are never accessible for calking after the material is fitted and riveted; while others do not prove satisfactory if calking alone be depended upon. Water-tight floors in wake of liners on outside plating and inner bottom; bulkheads or decks, in wake of plating of two or more thicknesses; the connections of framing behind armor to the armor shelf, are examples of the second case, and require the use of stopwaters. Various substances are used for this purpose, amongst which may be mentioned the following: Tarred hemp felt, plain or soaked in red or white lead; canvas soaked in red or white lead; sheet rubber; sheet lead; red lead putty; hempen or lamp-wick gaskets, soaked in white lead; asbestos; lead wire, and in some cases copper wire. Any one of these is satisfactory in a particular case, but different classes of work require different stopwaters. Where the joints of material are close fitting, or can be well drawn together in riveting, a strip of tarred hemp felt is generally used. This is the case with most of the lighter material, ½ inch thick or under, in hull work. Where the parts connected are very rigid, and are apt to stand some distance apart when riveted, a layer of felt is next to useless, as, being thin, it is not compressed between the plates. In these cases a thick layer of some plastic substance, such as red-lead putty, should be used. This will fill all the spaces between the parts as they are drawn together, and on hardening will form a solid joint. Rubber, lead, canvas, asbestos, etc., are principally used in connection with pipe work."

Proceeding to the question of testing double bottoms, comment is made as follows: "These compartments must be able not only to resist a certain water pressure without injury, or without allowing leakage into adjacent compartments in case of damage to the ship, but also to carry water as ballast on long voyages in case of necessity. Thus the importance of having them carefully inspected and made effectively water-tight is readily seen. When carrying water as ballast the maximum strain is due to the shock that is produced in pitching or rolling, when the compartments are not entirely filled. This at times undoubtedly equals or exceeds the strain due to a direct water pressure in case of damage, and, being intermittent, is more serious. The test then should be with a head of water considerably above the load water line. On the Alabama this head was 35 feet above the bottom of the keel, i. e., 11 feet 6 inches above the load water line, and I am of the opinion that, for a thorough test, all double bottom compartments in ships of about the same load draught should be tested to this height. Too great care cannot be taken to have them thoroughly tight."

In point of illustration, Assistant Constuctor Smith cites the following: "The importance of having the inner bottom thoroughly water-tight was strongly emphasized when the Brooklyn grounded in the Delaware river, Jan. 31, 1897. The ship lay for nine days with the outer bottom torn open for 126 feet of her length, and the inner bottom subjected to a pressure head of about 22 feet of water, yet no damage was done and practically no leakage occurred. The maximum deflection of the inner bottom plating was at first about ¾ inch and gradually increased to ⅞ inch. The plating was not shored down, but wood was packed loosely under the boilers to prevent serious deflection. When the inner bottom of this ship was first tested for water-tightness, it leaked seriously, so that all of the compartments had to be retested, and some of them a second time.

"The ends of a ship which are affected by the pitching motion are subjected to a varying pressure, often reaching 15 feet or more at the bow above the load water line. It appears then that these end bulkheads should be able to withstand a much greater pressure than those amidships, and that the testing pressure should be at least 10 feet or 12 feet above the load water line forward and somewhat less aft, and that they should stand up firmly under this pressure. For the forward bulkheads this means a pressure of about 35 feet above bottom of keel in our most recent battleships, a very heavy strain, requiring a strong bulkhead to resist it. When H. M. S. Victoria was rammed by the Camperdown, but a few minutes had elapsed before the bow was 13 feet under water, 23 feet below its normal position. This was before the ship lurched. With a head of water equivalent to the above, the forward lower bulkheads in our modern ships would not have stood the pressure, so that the question of the water-tight door, whether it were closed or open, would be of secondary importance, the bulkhead itself being at stake. I do not pretend to assert that the Victoria was lost owing to failure of her bulkheads, but I am confident that many of our own ships, when the conditions stated above was reached, would have gone down from that cause. The only safe course is to see that the water-tight bulkhead is sufficiently strong as a whole, then see that the door is closed. It is important that our ships be examined from this point of view if we hope to escape similar disasters.

"Probably the most difficult subject to be dealt with in connection with water-tight work is the protective deck, and the primary cause of the trouble is due to the method of construction adopted. As generally fitted it consists of three thicknesses, the two lower not exceeding 20 pounds per square foot each, and the upper of heavy plating of from 60 pounds to 120 pounds, the two lower thicknesses which form butt straps and edge strips for each other being riveted together and to the deck beams. The upper thickness is either riveted to the two lower or tap bolted to them from underneath. Leaks are extremely troublesome, as they are quite inaccessible. They should be remedied by so building the deck that they cannot occur. The first step to be taken in this direction is to reduce to a minimum the number of water-courses through which leakage may take place. This is best accomplished by reducing our protective deck of three thicknesses to one of two thicknesses, and as this subject affects the water-tightness to so great an extent a slight digression may be pardonable to consider why this change in construction is not only permissible but desirable. From sore experience on the Brooklyn, Iowa and Alabama I am fully convinced that a protective deck of three thicknesses can only be made water-tight by forcing red lead putty between the layers throughout the whole length, or by calking completely underneath as well as on top, beams, rivets and all; stopwaters being fitted in the latter case in wake of all beams. The amount of putty necessary to fill such a deck is large, from 10 to 20 tons, and will to a great extent counterbalance any increased weight of material in the two thickness deck, so that, if the deck of three thicknesses is made thoroughly water-tight it may, for the same thickness of plates, even exceed in weight the deck of two thicknesses.

"The same arguments that were advanced for reducing the thin layers of plating in the protective deck from two thicknesses to one apply equally well to the plating behind armor. Single seam straps, double riveted, fitted intercostally between the frames, or continuous with liners in wake of the frame, are quite as satisfactory, give greater strength, are much simpler, and can be worked at a much less cost. Such plating, calked along the outer seams, can easily be made water-tight and will remain so. The difficulty of water finding its way between the plates and all the consequent difficulties of making a water-tight joint between the plates in the armor bolt and armor-backing bolt holes are avoided, and the work of fitting the armor and backing is very materially reduced. When in two thicknesses the space between the plates forms an excellent storage place for water, which is ultimately bound to find its way there either from the outside or from the inside, and which will work its way out at will for a long period of time.

"Summarizing the conclusions already reached, there are certain very important features which, if more generally adopted, will undoubtedly give a much more efficient water-tight subdivision. These are: First, fitting of efficient rigid bracketing to all stiffeners on bulkheads below the water line; second, fitting of double bounding and staple angles to such parts of all bulkheads as may be below the water line; third, fitting of a vertical stiffening bar or double staples on all water-tight floor plates of a certain size (depending upon the class of vessel), except where the plate is in direct line and adjacent to a bulkhead above; fourth, fitting of the protective deck in two thicknesses instead of three; fifth, fitting of all plating behind armor in one thickness instead of two; sixth, the use of double riveted lapped butts and seams instead of strapped butts and seams in the case of the inner

bottom, platform and splinter decks and all bulkheads; seventh, as an alternative to the sixth feature, the fitting of a stiffening bar along the seams in the case of all light flush plating fitted with straps. The first three of these items are imperative, four and five very important, and the others desirable. In connection with these must be mentioned a general increase in the stiffness of certain important bulkheads, as already discussed. This I consider the most important feature of all.

"Nearly all of these suggestions call for an increase of weight, and the question will naturally be asked, What sacrifice can be made in the other elements of the design to allow of this increase? The question is an important one. It is evidently undesirable to cut down on any of the other features, but still if our ships are to be effective in every sense, as they undoubtedly should be, and are to represent a system of water-tight compartments, not only in theory but in practice, then of necessity an increase of weight is involved and some means must be found for supplying it. In the first plasce, a careful study of the action of material under water pressure will enable us to arrange it so as to get the necessary increase of stiffness on a minimum increase of weight. Secondly, some weight may be obtained by reducing the scantlings of certain parts of the hull, and by throwing this gain of weight into parts that have greater use for it. Thus, I believe a reduction can safely be made in the scantlings of most of the bulkheads on and above the berth deck, particularly the coal bunker and the inclosure bulkheads. Some saving of weight might be effected in other elements of the design, such as the machinery, battery, etc., but this must not be counted upon to counterbalance any increase of weight that may be found necessary in the hull. In the third place, if the necessary saving of weight cannot be effected as above, then it will be necessary to increase the displacement of the ship, keeping the weights of all elements but the hull the same, except for such increase in the machinery and coal capacity as shall be sufficient to compensate for the greater displacement. If a far better and more efficient ship can be built on 12,000 tons than on 11,000 tons displacement, to have the same fighting qualities, speed and coal endurance, then undoubtedly the former ship is the one to build, regardless of the increased cost."

OTHER OPINIONS ON WATERTIGHT WORK.

Opening the discussion, Naval Constructor John G. Tawresey declared that 50 per cent of the trouble regarding watertight work could be laid at the door of the draughtsman, and that the principles of water tight work were not sufficiently understood. "Moreover," said he, "many draughtsmen don't take the trouble to put into practice what they know. Mr. R. L. Newman said: "In the tests which we get on the great lakes we rely principally on longitudinal keelsons. We avoid all amidship joints, and the collision bulkheads which we have adopted give very satisfactory results." Naval Constructor Bowles was inclined to combat the statement that 50 per cent of the trouble was due to the draughtsman. "We always lay everything to the draughtsman," said he, "but I think 50 per cent is a little too much. It seems to me that the principal trouble is due to the electrician. After we have made the bulkheads thoroughly tight, the electricians come along and drill them full of holes." Mr. Smith stated that on the cruiser Brooklyn five men were employed for fourteen months in securing water-tight work, and he replied to a criticism by Lieut. White with the assertion that bulkheads were all the stronger for ventilating pipes passing through them by reasons of the castings fitted around them.

NAVAL CONSTRUCTOR J. J. WOODWARD.

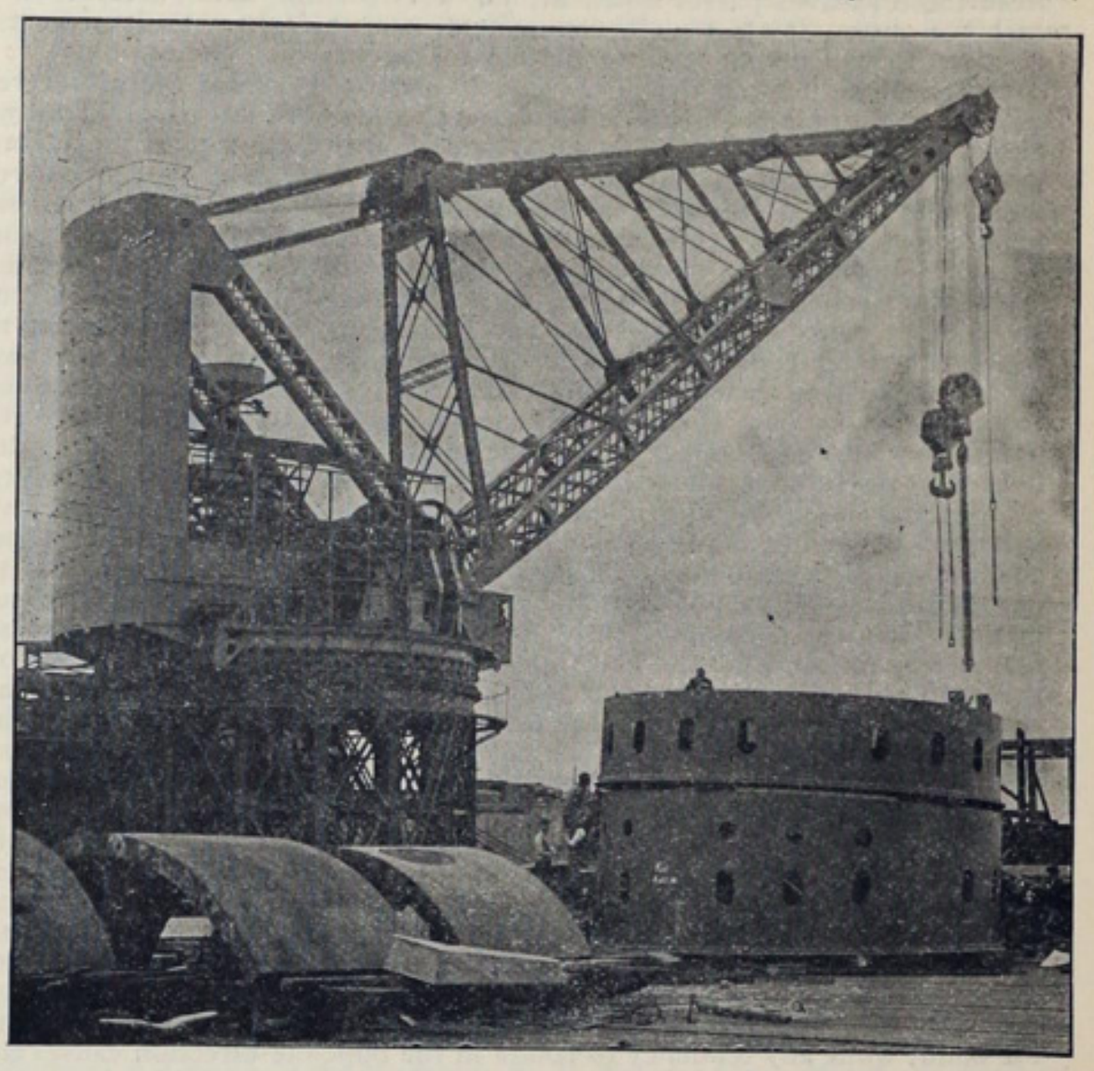
As the session was already prolonged, the members were furnished with copies and Secretary Bowles read by title the paper on "An Electrically Operated 150-ton Revolving Derrick," by Mr. Walter A. Post, superintendent of the Newport News ship yard. Mr. Post's paper is in part as follows:

ELECTRICALLY OPERATED REVOLVING DERRICK.

"Together with the demands of the day for greater capacity, greater power, and greater speed, as essential characteristics of the modern ship, there comes the dependent feature of greater weight, and to the ship builder, the problem attendant upon this feature, namely, that of providing for the economical handling of these weights. The plant of the Newport News Ship Building & Dry Dock Co., although well provided from its origin with appliances for handling material, was found in its later developments to be in need of apparatus more powerful and more convenient than the 100-ton sheer legs which, to that time, had been used for handling the heavier weights installed on board ships during the fitting out period. The growing need of such apparatus had been for some time forcing itself upon the attention of the company, but it was only in the spring of 1896 that it was finally determined to undertake its provision, and steps were taken to ascertain from the experience and opinions of experts, both in this country and abroad, what general type of machine would most satisfactorily fill the particular requirements of the Newport News plant.

"The fundamental requirements, briefly stated, were: Capacity to lift and place on board the heaviest single weight liable to be incurred in the probable development of modern ships; a field of operation, as large as practicable, in which these weights could be handled, and absolute precision within this field; a location accessible by the ordinary means of transportation from all parts of the yard; and, finally, that greatest factor defined in all projects by the broadest use of the word economy. Careful consideration of these requirements lead to the adoption of a 150-ton revolving derrick, electrically operated and controlled, mounted on a steel tower supported in turn by pile foundations. The structure was located on one side of a pier 700 feet long, forming one side of a slip, in which a number of ships may be moored at one time and readily brought within the field of the derrick's operation. Two standard gauge tracks over the entire length of pier afford means of transportation from any part of the yard, and also direct attention to the main lines of the Chesapeake & Ohio railroad system. The floor of the pier, 185 feet in width, furnishes ample room for the temporary reception of heavy pieces, castings, armor, etc., and permits in addition, the assembling of much work within direct reach of the derrick, thus allowing assembled parts to be placed on board as a single member, relieving the tendency to overcrowd floor space in the shops and effecting a saving in cost over work as assembled on board ship.

"The derrick jib is capable of having its outer end raised or lowered, thus giving to the hoisting blocks, which depend vertically from this end,



THE 150-TON REVOLVING DERRICK AT THE NEWPORT NEWS YARD.

a movement not only of rotation about the centre of the derrick but also of translation in or out from this centre. With the outer end of the jib in its lowest position the hoisting blocks will, on rotation of the derrick, describe the circumference of a circle 207 feet in diameter; with the jib in its highest position these blocks, on rotation describe the circumference of another concentric circle 88 feet in diameter, thus permitting the derrick to operate on weights lying anywhere within the circle ring whose maximum and minimum diameters are 207 feet and 88 feet respectively. The maximum load of 150 tons can be handled only within a ring whose maximum and minimum diameters are 147 feet and 88 feet respectively, but weights up to 70 tons may be handled throughout the entire field of operation. This feature, of varying the radii at which the hoisting blocks can operate, constitutes a most important difference between the derrick under discussion and the 130-ton steam crane erected, in 1893, on Finnieston Quay, Glasgow. In the Finnieston crane, which at the time of its construction represented the ideas of best English practice, there is no variation in the radius at which the hoisting blocks are carried, and, in consequence, the field of operation becomes narrowed to a single line, the circumference of a circle described by the blocks on revolving the crane. The advantages of the Newport News derrick are obvious. The maximum elevations, above mean high water, for the hoisting hooks in the high and lower positions of the jib are 118 and 69 feet respectively; this giving ample clearance vertically for any probable conditions.

"The derrick is revolved by duplicate sets of machinery, each consisting of one No. 800 General Electric railway motor, capable of developing 20 horse power , and driving, through means of a double threaded worm and wheel of the Albro-Hindley pattern, a pinion which, engaging a horizontal circular rack on the outside of the tower, gives the required movement of rotation. The motors are series wound and controlled from a series parallel controller, giving high efficiency under starting conditions as well as at normal speed. The turning motion is very smooth and perfectly noiseless, and, as will be seen from the tests, requires very little power. The racking movement of the jib is effected as follows: At the inner and upper apex of the jib is a 10-inch steel pin carrying twenty-two cast steel sheaves, each sheave of 5 feet pitch diameter. At the upper apex of the housing is another 10-inch steel pin carrying twenty-four similar sheaves. Leading over these two sets of sheaves, and sustaining the weight of the jib and load, are two 1¼-inch steel wire ropes; each rope being wound on alternate sheaves and each end of each rope brought down to separate drums, located below in the housing; this arrangement ensuring freedom from side twisting on the sheaves and also requiring each rope to take its share of the weight. The four drums, on which these ropes are wound, are arranged in pairs, each one of a pair taking opposite ends of the same rope and each pair driven by a No. 2000 General Electric series motor of 100 horse power; the power from the motor being transmitted to each drum through a separate train of gears. The drums are of cast iron, 5 feet pitch diameter, carried by 7-inch steel shafts. Each rope, having 22 parts, is strong enough to sustain and operate the jib when under maximum load, thus guarding against accident and enabling either motor to be disconnected, and the rope, which it controls, to be removed for repairs or renewal. The motors are series wound, which ensures each taking its proper share of the load.

"Passing to the hoist, we have two main hoists, each of 75 tons capa-

city, and one 20-ton whip for lighter loads. The main hoists are each of twelve parts, 1¼-inch steel wire rope, leading over six sheaves, 5 feet pitch diameter, carried on a ten-inch steel pin at the outer end of the jib. The lead from these sheaves to the operating drum is carried down the jib on wooden roller runners. These drums, one for each hoist, are of cast iron, 8½ feet pitch diameter, carried on 7-inch steel shafts, and each driven, through a train of gears, by a No. 2,000 General Electric 100-horse power motor, series wound. These hoists may be coupled together and operated as one hoist of 150 tons capacity. The 20-ton whip is of three parts, 1¼-inch steel wire rope, carrying a single block and leading over two sheaves, carried, as are those for the main hoist, at the outer end of jib. The lead from these sheaves passes down the jib, over a single guide sheave, to a cast iron drum, 8½ feet pitch diameter, driven, through a train of gears, by a No. 2,000 General Electric 100-horse power motor, series wound.

"It will be noticed that electricity is used to generate the power required for all the movements of the derrick. The question involved in the choice as to the form of energy to be employed in such a machine cannot be fully discussed here, but the convenience of operation, ease of movement, and general efficiency of the present derrick attest the successful use of electricity in this case. Current is transmitted over heavy insulated copper wire to fixed brushes attached at the center and near the top of the steel tower. These brushes are arranged to bear against circular contact rings insulated from, but carried by, the center casting to which the roller rods are secured. Near the top of this casting are two more contact rings which transmit the current to a pair of brushes, fixed to the revolving part of the derrick, from which the current is delivered over heavy insulated copper wire to the several motors. The current is delivered to the motors, under normal conditions, at a pressure of 220 volts.

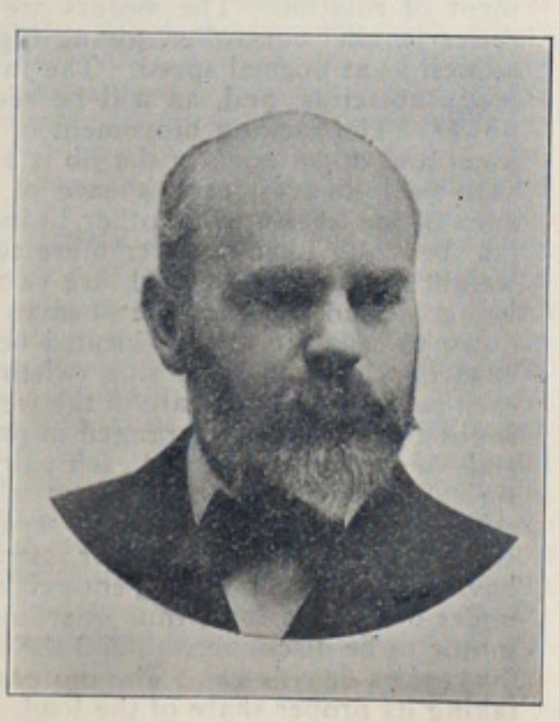
"It may be interesting to note a few particular features, and to give the result of such tests as opportunity has permitted up to the present time. The brakes are a feature of considerable interest. These were required to occupy little space, be powerful and certain in their action, and to be automatic. This was accomplished by extending the ordinary band brake so that it wound four and one-half times around a brake cylinder carried on the shaft to which is keyed the pinion that meshes into the gear of the operating drum. This brings the brake in as direct connection with the load as possible and guards against accidents of the machinery. The brake cylinders are of cast iron, 30 inches in diameter, with the wearing surface chilled. The band is of wrought iron 1 inch thick, 5 inches wide at one end, and tapering to 1¼ inches at the other. The broad end is firmly anchored, while the narrow end is secured to a lever carrying a weight of 200 pounds. When lowering the jib or the hoisting blocks, the direction of rotation for the brake cylinders is toward the small end of the band, so that the friction, produced by the weight, between the cylinder and band, causes the band to wind tight on the cylinder and stop rotation. In hoisting, the brake releases itself, the friction lifting the weight and uncoiling the band; while any tendency to rotate in the opposite direction causes the weight to fall and the band to tighten. To release the brake it is only necessary to lift the weight, which is done by means of a wire connecting with a lever in the operating house; the lever being always within reach of the operator and the brakes always in operation except as released by continuous pull on the lever. The operating station is directly underneath the lower end of the jib, overlooking directly the weights to be handled, and encased with glass front as a protection to the weather. The controllers for the several motors are within easy reach of a single operator, who is thus given convenient and absolute control over the varied movements of the derrick. The ropes for the hoist and racking movement are all of plough steel wire, 1¼ inches in diameter, of six strands of thirty-seven wires each, with hemp center and very flexible. Each rope has a breaking strength of 100,000 pounds. The gears throughout, except the worms and those supplied with the motors, are of cast steel with cast teeth, the pinions being full shrouded. These gears work very smoothly and show a high efficiency.

"The most difficult problem encountered in the design of the derrick was that of providing a safe and efficient way of operating the jib, and, in so far as the author knows, the method adopted is, considering the large forces involved, something of a novelty. The results obtained and the efficiency of the mechanism would indicate that the problem had been well solved, and that the idea here carried out might, with advantage, be extended by other designers to future problems."

THE PAPER OF PROF. CECIL H. PEABODY.

The final paper of the meeting was that on "Stability of a Battleship Under Damaged Conditions" read by Prof. Cecil H. Peabody.

A paper presented at a meeting of the society in 1896 by James Swan dealt with an experimental investigation of the stability of a ship in damaged condition by the aid of a wooden model. This paper, which was entitled "Use of Small Models for Determination of Curves of Stability," gave an account of the apparatus and methods employed for these experiments at the Massachusetts Institute of Technology. Prof. Peabody's paper gives the results of application of the same methods and apparatus to a recent battleship. Principal dimensions of the type of ship selected for this second series of experiments and calculations were: Length between perpendiculars, 368 feet; beam, 72 feet; normal draught, 23½ feet; height of main deck above normal water line, 11 feet. The ship under consideration was one of a thick armor belt extending from the aft turret to the stern, the thickness being reduced toward the bow. A transverse armored bulkhead connects the after ends of the belt to the turret foundation, and another armored bulkhead extends across the ship just forward of the boiler rooms. Between the bulkheads there is a flat armored deck on top of the armor belt, and outside of the bulkheads at both bow and stern are armored protective decks with sloping sides. The armor belt, the armored bulkheads and the armored decks serve to protect the buoyancy and stability of the ship as well as to guard the propelling machinery and magazines. Above the thick armor belt, thinner side armor is carried up to the main deck for a space extending from turret to turret, and is joined to the turrets at the ends by transverse bulkheads. This armor affords additional protection to the buoyancy and stability, as do also cofferdams filled with cellulose. The investigations were intended to show the effect of such injuries as would admit water to the compartments on the protective deck outside of the armored transverse bulkheads, and also the effect of flooding certain of the compartments below the armored and protective decks. For this purpose an accurate wooden model was made on the scale of one-fourth of an inch to the foot. The model was made in two parts, one representing the lower body of the ship, up to the armored and protective decks, and the other representing the upper body between the main deck and the armored and protective decks. Disks to represent the turret foundations were cut out and fixed to the model of the lower body. The superstructure above the main deck was omitted from the model, as it was considered safer to neglect the additional stability that could be attributed to that part of the ship. The lower body of the model was divided longitudinally over the keel to facilitate the removal of parts representing compartments at one side only. The model, with the inclining apparatus in place, was ballasted so that it floated at the proper water-line, and so that it had the proper metacentric height. Then blocks representing the parts which were supposed to be laid open to the sea were cut out and lead weights were fastened to compensate for the wood removed. The initial inclination for a given condition was then determined, and also the change of time as well as the new water-line. Then inclining experiments were made to determine the initial stability, and also the stability at various angles of heel.



PROF. C. H. PEABODY.

Accompanying this description of the kind of ship under consideration were a large number of drawings which served to make clear the summary of the tests presented by Prof. Peabody.

In the topical discussion of the question, "Under the Circumstances of the Blockade at Santiago, which was the More Economical Method of Maintaining the Boilers in Readiness for Immediate Action—Banking the Fires or Keeping Them Spread Very Thin?" interest was contributed at the outset of the reading by Mr. John C. Kafer of a letter from Chief Engineer Milligan of the Battleship Oregon.

The letter of Chief Engineer Milligan of the Oregon was as follows: "On the Oregon we kept our fires spread and thin. I did that more for mechanical reasons than anything else; that is, to save the boiler from cold air getting in and striking the tubes. We consumed from twenty-four to twenty-seven tons per day. It must be borne in mind that the engines were used frequently to maintain our position, there being about 200 fathoms of water we could not anchor. The Iowa kept nearly all her boilers banked and enough spread to handle engines. She always (at noon, when we all signaled to flag-ship, the coal burnt and amount on hand) consumed from four to six tons more than we did. We had to use our bleeders frequently, and, of course, there was a waste. I would say banked fires would be more economical on coal alone, but under the circumstances I always said 'dam the economy; efficiency is what we want,' and my actions were governed accordingly.

"Difficulty in maintaining water in boilers, fresh, varied on different ships. You might say it was a local question. None could be had from shore or any other source except the ships themselves. It depended upon the number of leaks, what I call illegitimate losses, and the peculiar ideas some medical officers had about the purity of distilled water. All our evaporators want to be increased about 50 per cent. Those furnished to the Oregon would make the amount they were rated (5,500 gallons per day) but the water showed considerable salt under nitrate of silver test. Still we never had any trouble among the men from drinking it. Our doctor passed it, but with the remark that it was very bad water. Other doctors insisted on the water showing no salt at all, but that would decrease the output of the evaporators fully one-half, as they had to be run so much slower. I noticed on ships where the distillers were some height above the evaporators that better water was made, and would recommend 20 feet if possible. Only the distillers need be there; the pumps, etc., down alongside evaporators so as to reduce number of men to run the plant. The Oregon was remarkably free from leaks, but she would use about 2,000 gallons per day to make up losses in feed.

"We had no trouble with our machinery. From all I can hear of other ships, condenser tubes gave most trouble. The remedy is to use heavier tubes, nothing lighter than No. 18 B. W. G., and No. 17 would be better. In all the new ships there is a great deal of auxiliary machinery seldom used, but in an emergency all is used. Not being used it is liable to be neglected. We had a well established routine to move all this machinery every day, and if for any reason it could not be done, the reason was entered in the steam log. If this is attended to, I see no reason why any difficulty can occur. We had hydrokineters in our feed tanks, and always kept feed water at the constant temperature of 140 degrees. No drains led into the feed tanks except from traps of evaporators; all other drains either led to auxiliary or main condensers. Some ships have all the drain discharge into feed tanks. This keeps them too hot and gives trouble. I forgot to mention that nearly all ships had trouble with cold salt water copper pipes from pitting. This is easily overcome, however, by sweating soft patches on; had some on Oregon patched nearly a year and gave no trouble. Where salt water was used in boilers their crown sheets invariably came down. Quite a number were crippled from this."

Passed Assistant Engineer McFarland contributed a table made up from the logs of our principal battleships and tending to show that spread fires were more economical. Mr. Lewis Nixon, who was in attendance at the afternoon session for the first time during the meeting, called attention to the public interest in life saving appliances on passenger and mercantile steamers, with the comment that little progress along this line seemed to have been made since the earliest times. At the conclusion of his remarks Mr. Nixon offered a resolution, which was unanimously adopted, to the effect that papers on the subject of life-saving at sea be invited and that two such papers be selected for presentation at the next annual meeting of the society. Resolutions were also passed thanking the American Society of Mechanical Engineers for their courtesy in extending the hospitality of their home and thanking President Griscom and Secretary Bowles for their efficient work.

THE ANNUAL BANQUET.

A REPAST AT DELMONICO'S FOLLOWED BY SPLENDID ADDRESSES BY MEN PROMINENTLY IDENTIFIED WITH NAVAL AND SHIPPING INTERESTS.

A very pleasant as well as invaluable feature of the gathering was the annual banquet which was held on Friday evening, Nov. 11, at Delmonico's new home, corner of Fifth avenue and Forty-Fourth street. The rooms and tables were handsomely adorned in the national colors and the elaborateness of the decoration extended to the favors which were in the form of miniature ships with full sails set. More than a hundred of the members and their friends were present. The program of toasts was as follows: "The President," "Our Navy; It Has Justified Its Existence and Glorified the Nation," Harvey D. Goulder; "Our Commercial Marine, Its Development and Extension is a National Necessity," Hon. George F. Edmunds; "The Naval Militia," Capt. J. W. Miller; "Naval Architecture," Lewis Nixon; "Marine Engineering," W. M. McFarland; "Our Manufacturers," Theo. C. Search; personal toasts by Charles C. Haswell, Charles Ward, William H. Webb.

The mention of the names of Admiral Dewey, Hobson, Col. Roosevelt, formerly assistant secretary of the navy, and others were given most enthusiastic receptions and hearty cheers were also given for President Griscom, Dr. Charles H. Haswell and Secretary Francis T. Bowles.

In responding to the toast "Our Navy" Mr. Harvey D. Goulder said: "We have more ships on the great lakes than all other parts of the country, because our laws give us the benefit of the great commerce which must be carried on. Why is it not so in the foreign mercantile marine? Why will our people permit our millions of tons of freight to be carried in foreign ships? Admiral Dewey achieved a victory which makes not only his name but the name of the American navy immortal forevermore. Think of the record of our navy because we had bravery and skill and back of it all because we had the ships. How long, though, are we to stand on the record of what our navy has done? Or shall we not build up a foreign merchant marine that shall do honor to our flag as the navy has done honor to it?"

Senator Edmunds spoke in part as follows: "We must look now, in consideration of our enormous development, to find places to dispose of the products which the industry of our people has produced. We had for many years to admit that Great Britain was mistress of the seas." A voice "She is now." "No, sir" replied the senator "the United States is now. We now have the question where are the markets to which the surplus of our products may be sent? The place for American commerce is the eastern coast of Asia. If you take the Philippines as a market it will turn out almost nil because it is almost in the heart of the tropics where the people have few wants. The markets of the world are to be found in the temperate zones. The people who can consume things and who can pay for them—and that is an essential requisite—are the people who live in the temperate zones. Therefore it seems to me that the place to which Americans should give their attention are the temperate zones of Asia and therefore many of us are in favor of the Nicaragua canal. Moreover, I am not in favor of any private corporation in that business; it should be national. Once before we thought the construction of this canal was all but an accomplished certainty, but at that time there were influences in the senate which thought that it would not be honorable to Great Britain to build the canal and it was not built. Now we are again facing the question of the welfare of our commerce, and I hope that for the sake of that commerce you will all urge your senators and representatives to push the Nicaragua canal project, not by anybody's corporation but under the authority of the United States exerted by itself.

"The opening of the canal would do for America all that the opening of the Suez canal did for Great Britain—and we all know that the Suez canal belongs to Great Britain—and then shall we indeed become masters of the commerce of the world. This is the mission of the congress of the United States and it is the mission of you ship builders and marine engine builders that you should do what we have failed to do for so many years—exert every power to induce the United States to build up and support a merchant marine. That is the thing which will furnish us the means to develop our resources, and you all know how easily this can be done if congress will stop talking and go to voting. We have a navy which is ship for ship, man for man and gun for gun the equal of anything the world has produced, and now with that accomplished let us devote ourselves to the upbuilding of our merchant marine."

Capt. Jacob Miller in responding to the toast, "The Naval Militia," said a good word for the officers of the navy who wanted to get to the front but couldn't, and as an illustration of what they accomplished, even while staying at home, he cited that at the New York navy yard alone 150 ships were fitted out. His comment on the subject of his toast may be well summarized in the opening sentence: "There were some little things done by the auxiliary navy of the United States that were well done."

Mr. Lewis Nixon paid a glowing tribute to the members of the construction corps of the navy. Said he: "The construction corps has not only produced the best ships but has worked with the engineering corps and produced vessels that have challenged the admiration of the world." He declared that the United States is on the eve of a great era, and called attention to the progress of Germany as a ship building nation since 1885. "The experience of the past war," he continued, "was such as to call attention to our ship yards, and no one found fault with the uniform excellence of the vessels turned out by those yards."

Passed Assistant Engineer McFarland made an address of the highest merit. "One reason we gained victory over the Spaniards," he declared, "is because we are a nation of mechanics, and the Spanish are not. Unless the officers of a vessel have mechanical instinct they most certainly cannot have success." He referred in glowing terms to the trip of the cruiser Columbia across the Atlantic and that of the Oregon around the Horn. He also emphasized the importance of co-operation, and in evidence of the value of this pointed to the fact that at the battle of Santiago within fifteen minutes after the signal was given to steam ahead, the Oregon was making15 knots.

In response to a most vociferous demand, Secretary Bowles made a few remarks, in the course of which he said: "I see in the very near future great activities for our profession and I realize that whatever the navy is or will be, and whatever the commercial marine may be, it will be due to the members of this society."

A REPRESENTATIVE GATHERING.

MEN IN ATTENDANCE IDENTIFIED WITH EVERY PHASE OF INTERESTS FOR THE FURTHERANCE OF WHICH THE SOCIETY IS DESIGNED.

On Saturday, Nov. 12, a large number of the gentlemen in attendance at the meeting accepted the invitation of the Bethlehem Iron Co. to visit its plant at South Bethlehem, Pa., and the greater part of the day was spent very profitably in witnessing the demonstration of all the processes attendant upon the manufacture and testing of steel forgings and armor plate. It would not be just to conclude any mention of the New York meeting without some expression of the universal recognition on the part of all members of their indebtedness to the secretary, Mr. Francis T. Bowles, to whose energy and untiring exertion so much of the pleasure and benefit of the gathering must be admitted to be due. Mr. Bowles' occupancy of the position of naval constructor in charge of the Brooklyn navy yard might naturally be expected to leave him scant opportunity for attention to any other interest, but no one in attendance at the New York meeting of the society could have failed to appreciate the enormous expenditure of time and labor entailed in the perfection of details to the degree necessary to insure a meeting so highly successful in every particular. That he should make such endeavors for a work which is at best a labor of love, speaks well for the generosity of Mr. Bowles and his interest in his profession, and if gratitude constitutes anything of a commendation the secretary must also realize that his beneficiaries are at least not lacking in appreciation.

Among those present at the meeting were the following: Harvey D. Goulder, Frank J. Firth, Henry P. Booth, Theo. C. Search, Hon. Geo. F. Edmunds, John L. Waterbury, William H. Baldwin, Jr., Clement A. Griscom, Naval Constructor F. T. Bowles, Jas. M. Belford, William H. Deming, Geo. Rowland, Chas. B. Rowland, Geo. N. Gardiner, Chas. H. Haswell, C. A. Griscom, Jr., Arthur Krause, J. Gordon Emmons, L. Katzenstein, J. Katzenstein, Robert Russell, A. Moritz, U. S. N., John Loyd, F. L. Dubosque, Spencer Miller, H. N. Creel, Andrew Fletcher, Andrew Fletcher, Jr., H. N. Fletcher, W. H. Fletcher, E. R. Mead, J. W. Shackford, John D. VanBuren, Alfred G. Smith, Chas. H. Loring, Jas. Barre, S. Putman, L. B. Libbey, T. F. Newman, Stevenson Taylor, W. D. Forbes, Prof. C. H. Peabody, Meirs Coryell, C. Lufkin, Darwin Almy, L. R. Pomeroy, Wm. E. Volz, Wm. D. Dickey, Thos. Cingdon, Howard Pusey, Edward P. Robinson, Rus W. Davenport, J. R. Andrews, Louis Silva, H. F. J. Porter, Lewis Nixon, R. L. Newman, J. H. Mancor, Wm. Nish, A. McDermott, M. Hume, John N. Robins, R. C. Veit, W. H. Starr, A. K. Bouton, W. I. Babcock, John C. Kafer, Geo. E. Weed, Wm. Rowland, Wm. H. Bailey, W. M. McFarland, U. S. N., Naval Constructor F. L. Fernald, Prof. Wm. Durand, D. G. Moore, M. Woodburn, E. Platt Stratton, F. B. King, H. A. Magoun, Gustav Tuska, H. H. Suplee, H. Deb Parsons, Capt. J. W. Miller, Thos. F. Rowland, J. H. Gardner, Samuel J. Clarke, Alex. Pollock, A. R. Smith, Chas. Ward, Warren E. Hill, T. F. Rowland, Jr., Chas. E. Hyde, E. A. Stevens, Wm. H. Allderdice, U. S. N., John F. Kane, H. C. Felton, Chas. W. Pusey, Erastus Wiman, Henry Steers, J. Edson, W. P. Stephens, J. A. Thomson, Naval Constructor J. H. Linnard, Capt. W. C. Wise, U. S. N., Naval Constructor J. G. Tawresey, Naval Constructor J. J. Woodward, Irving Cox, Chas. H. Corbett, Walter Aucker, F. D. Herriman, Mr. McIrvine, E. E. Roberts, R. M. Watt, F. W. Hibbs, H. G. Smith, E. P. Robinson, William Boyd, J. C. McGuire, J. C. L. Byrnes, Howard Wood, James Swan, A. Packard, Lieut. William C. White, U. S. N., G. R. Ferguson, F. W. Wheeler, E. Elinquist, William L. Bulkley, Fred. L. Lepine, Henry S. Epes, H. E. Boucher, A. J. Oliver, Hiram Meeker, William Haughton, F. B. Southard, James A. Hargan, William E. Winant, J. D. Williamson, Jr., B. F. Wood, John J. Swan, William B. Beckley, Warren E. Hill, W. L. Mintraye, J. B. Hoover, J. B. Hoover, Jr., G. W. Magee, William Rogers, C. R. Hanscome, E. A. Magee, John Platt, J. R. Andrews, C. P. Paulding, W. D. Forbes, William R. Sattler, R. W. Steele, Harry S. Fulton, Jesse N. Smith, S. J. Clark, A. J. McLean, C. W. Whitney, A. Kirby, Frank Grogan, T. C. Zeregn, J. Derycke, William Wylie, Henry C. Meyer, Jr., Henry Steer, James Eilson, Alfred Newell, S. S. Jordan, H. T. Rowley, Henry G. Barbey, Clinton H. Crane, John B. Hoover, U. S. N., G. Fred. Tweedy, and H. C. Wintringham.

OUR SUPPLEMENT—TURBINIA AT FULL SPEED.

The Review presents as a supplement to the current issue a striking new picture of the Turbinia steaming at a speed of 35 knots an hour. Especial interest attaches to this type of craft now, by reason of the announcement that the Parsons Steam Turbine Co., which was formed to take over Mr. Parson's patent in August of last year, has just taken possession of one of the most complete and fully equipped engineering works in Great Britain, and this despite the fact that the site for the works was not secured until September a year ago. The company is not yet prepared for ship building, but is proceeding with the erection of two sets of turbine engines, one for a foreign torpedo boat destroyer, the order for which was placed a year ago, and the other for a torpedo boat destroyer for the British government, which was ordered last March. Each is to be 200 feet long and fitted with engines of 10,000 horse power. These destroyers will be twice the length and six times the weight of the original Turbinia, which we illustrate. That vessel is 100 feet in length, 9 feet beam and has a displacement of 44½ tons. The engine originally fitted in the Turbinia was designed to develop upwards of 1,500 actual horse power at a speed of 2,500 revolutions per minute. The boiler is of the water tube type, suited to 225 pounds working pressure, the heating surface aggregating 1,100 square feet and a grate surface of 42 square feet. Two firing doors are provided, one at each end. The stokeholds are closed and the draught furnished by a fan coupled directly to the engine shaft. Later, the single turbine engine was removed and replaced by three separate compound turbines directly coupled to three screw shafts. The picture presented is from a photo by West & Son, Southsea, and was taken during a recent special run on the Tyne.

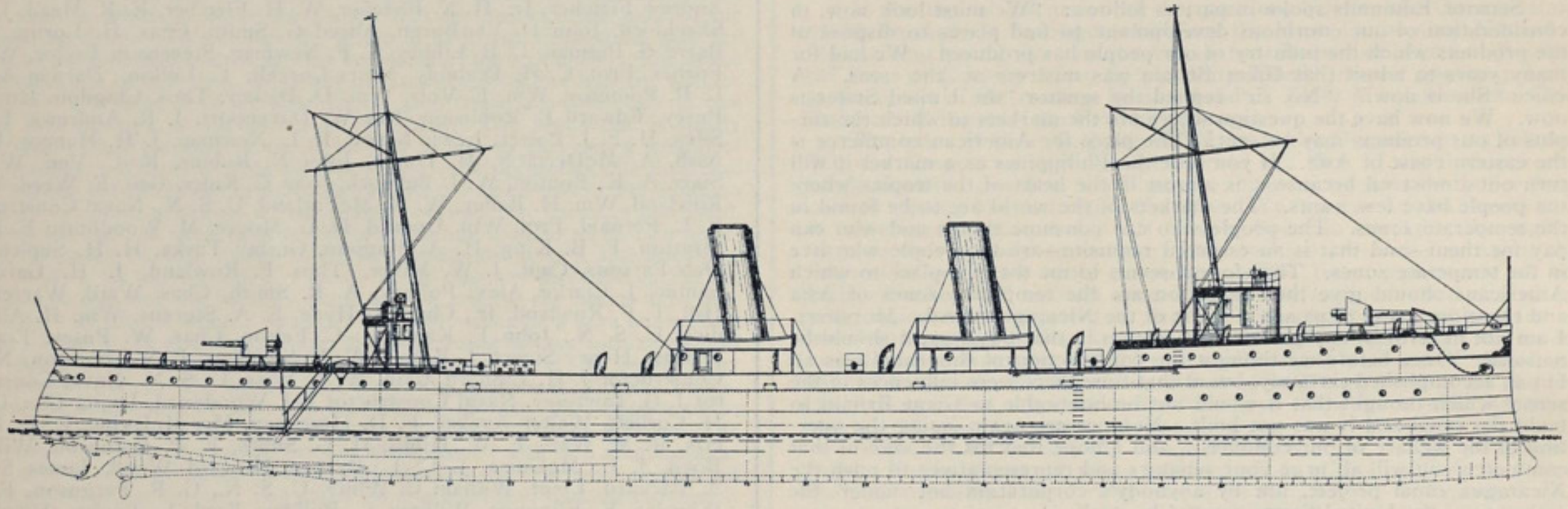
For Thanksgiving day a rate of one fare and one-third for the round trip has been authorized to points within 150 miles on the Nickel Plate road. Good going Nov. 24. Tickets good returning until Nov. 25. 267

TORPEDO BOATS.

A HIGHLY INTERESTING AND COMPREHENSIVE DISCUSSION OF THE WHOLE SUBJECT OF TORPEDO BOATS, DESTROYERS AND SUBMARINE CRAFT BY OFFICERS OF THE UNITED STATES NAVY BEST QUALIFIED THEREFOR.

UNANIMITY OF OPINION CONTROVERTING THE POPULAR IMPRESSION THAT PERFORMANCES OF VESSELS OF THIS CLASS IN THE SPANISH-AMERICAN WAR WERE IN A MEASURE DISAPPOINTING—LIEUT. COMMANDER KIMBALL, COMMANDING THE ATLANTIC TORPEDO BOAT FLOTILLA, AND OTHER OFFICERS MAKE VALUABLE CONTRIBUTIONS—CRITICISM OF OUR VESSELS IN COMMISSION OR BUILDING.

Probably the most valuable and easily the most spirited and interesting discussion of the meeting of the Society of Naval Architects and Marine Engineers at New York was that embodied in consideration of the subject of torpedo boats, destroyers and submarine craft. Owing to the similarity of the problems involved it was decided to consider simultaneously the paper presented by Supt. Geo. W. Dickie of the Union Iron Works, San Francisco, on "Torpedo Boat Destroyers for Sea Service, with Special Reference to the Conditions that Prevail on the Pacific Coast" and the subject assigned for topical discussion "The Utility of Torpedo Boats, and Has the Submarine Boat a Place?" In this connection communications, which are herewith reproduced, were presented by the officers of the United States navy who best fitted by education and experience to discuss the subject and who were unable to be present. Incidentally Captain W. H. Jacques was accorded the courtesy of the floor for the presentation of a paper (illustrated with stereopticon views) on the submarine boat. Taken collectively, these papers constitute unquestionably the most valuable presentation yet made of torpedo-boat practice with reference to the needs and requirements of United States navy. The papers by Mr. Dickie and Capt. Jacques, together, with the communications from the naval officers, are herewith presented in full.



OUTBOARD PLAN OF THE TORPEDO BOAT DESTROYER DESIGNED BY G. W. DICKIE OF THE UNION IRON WORKS, SAN FRANCISCO.

TORPEDO BOAT DESTROYERS.

MR. G. W. DICKIE OF THE UNION IRON WORKS, SAN FRANCISCO, DISCUSSES A TYPE FOR SEA SERVICE WITH SPECIAL REFERENCE TO CONDITIONS THAT PREVAIL ON THE PACIFIC COAST.

Important naval events are occurring in such rapid succession, modifying opinions that we had maintained as perfectly sound, and forcing others to be abandoned that we had considered as firmly established, that any attempt to produce a paper on the subject I have been requested to write upon may fail to express the opinions of the author when it comes to be presented before the society. In fact, this is the third attempt (begun on the first of August) to put in presentable shape the conclusions arrived at in regard to the chief characteristics required in a design of a torpedo boat destroyer that would meet all the conditions of service on the Pacific coast.

On the first page of a paper that I have just laid aside as not expressing the opinions I now hold, I find the following, that expresses the difficulty of presenting this subject: "I feel at the present date (April 25, 1898,) that I am running some risk of losing any little reputation that I may now possess by the expression of opinions that the stern facts of actual service in war may prove to be entirely wrong. Still, I desire, if possible, to complete this paper before anything happens that would in any way modify the opinions I now hold in regard to the utility of the latest developments in the construction of the type of vessel known as the torpedo boat destroyer."

More events have taken place since the above was written than usually occur in three months of naval history. In fact, these three months have provided material enough for naval architects, marine engineers and ordnance experts to form opinions from for years to come. It takes time, however, to form opinions, and more time to give them anything like practical form, and still more time to test the material forms into which these opinions finally shape themselves. The opinions expressed in this paper have not been entirely formed from the naval events of the past three months, although some of them have been modified by these events. The conditions of service are not altogether those that war produce. A seaworthy vessel must possess many and varied qualities apart from those belonging to the special service in which the vessel is engaged. A vessel built with the special object in view of carrying large cargoes at a low rate of speed and a low rate of freight must have, besides capacity to carry, the ability to safely meet the storm conditions of the ocean on which she and her cargo are borne. A fast passenger steamship, built with the special object in view of obtaining the greatest possible speed within the paying limits of the service, must still conform to the stern requirements that the ocean imposes on all those who "go down to the sea in ships and do business in the great waters."

A torpedo boat destroyer must possess other qualities than those necessary for the destruction of torpedo boats. In fact, the destroyer must be a sea-going vessel, able to remain at sea with the fleet to which she is attached or to make independent voyages. The torpedo boat is intended, if the writer understands the purpose for which such craft are designed, as a part of harbor or coast defense, to be kept under shelter until a chance occurs for her to dart out, under cover of night or fog, and attempt to sink a hostile vessel or vessels. Her work is, therefore, short and sharp, requiring a supreme effort, well directed and of short duration. The work of the torpedo boat destroyer is to prevent the torpedo boat attack, and is, therefore, performed in open water. She must keep the sea with the attacking fleet, watching every place of refuge for a torpedo boat. She must, therefore, possess speed equal to that of the torpedo boat; a battery powerful enough to destroy her; sea-going qualities to enable her to keep a watch in spite of weather. She should be able to cover long distances at a high rate of speed and in stormy weather. The fleet to which she is attached should not be delayed and hampered by guarding her from harm; she ought, instead, to be able in all kinds of weather to act as a scout in advance of the fleet, keeping the larger vessels informed as to the whereabouts of a possible enemy. Such would be an ideal torpedo boat destroyer.

It cannot be said that the present type of torpedo boat destroyer comes near meeting these requirements. Quite a large number of destroyers now meet the requirements, in the matter of speed, if required for a short time only, in smooth water, and if she is in good order; but the one quality of speed has been made paramount to all other qualities to such an extent that the full speed can only be reached when the conditions are such that the sea-going qualities can be neglected. It is because we think that the most important qualities required in a sea-going vessel are deliberately neglected in the fastest torpedo boat destroyers, and which we feel renders such vessels entirely unfitted for service on the Pacific coast, that we have mustered courage enough to state, as plainly as we can in words, the deliberate opinions we have formed on this subject.

While the conditions of service for such a vessel on the Pacific coast are not different in kind from those that prevail on the Atlantic seaboard of this country, the adverse conditions are far greater on the Pacific. The great distance between harbors on the Pacific coast and the almost universal condition of rough water along the coast from Point Conception in the south to Cape Flattery on the north, with only one place of refuge, renders it necessary that any vessel for practical service outside the harbor of San Francisco or the smooth waters of Puget sound must have good sea-going qualities and be able to remain outside in all conditions of weather. The qualities necessary for this service are not possessed in any degree by the present type of torpedo boat destroyer. While they have made voyages of considerable length at sea, they have done so usually under the care of a larger vessel. They have needed extra care, both in watching the weather, taking advantage of every shelter that lies in the way, and if the destination is reached without mishap, it is something to be proud of, as being entirely outside of the service for which the vessel is fitted. Now, such a vessel in commission on the Pacific coast cannot go from San Francisco harbor to any other harbor without making an ocean voyage of several hundred miles, with a probability of encountering rough weather. The disastrous results of many late attempts to steam or tow light craft to Alaskan waters, most of them better able to stand rough water than the fastest type of torpedo boat destroyers, show the necessity of substantial sea-going vessels for service on this coast. The 420-ton

detsroyers lately ordered by our government are a decided improvement in this class of vessel, but we do not think they are fitted even yet to meet the special conditions of service on the Pacific.

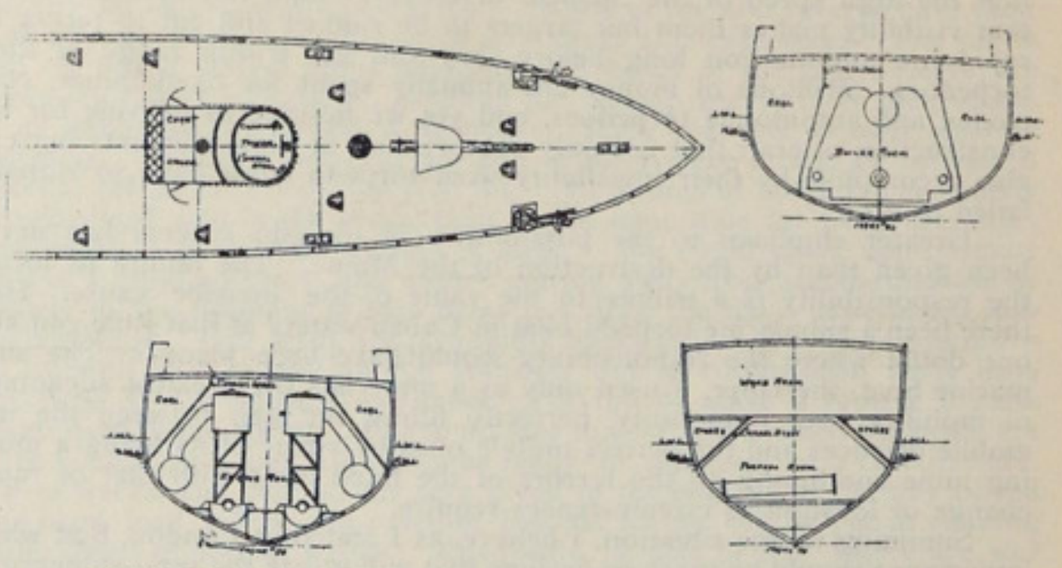
The annexation of the Hawaiian islands requires a much greater radius of action for such a vessel, and, we think, a different treatment. In fact, we maintain that if 30 knots or over is aimed at as the supreme speed, a sufficiently staunch sea-going vessel cannot be produced in the present state of the art, and that the present so-called 30-knot torpedo boat destroyers have not, in fact, the speed with which they are credited as being available when required. The supreme efforts required, under expert management and with special trial trip crews, to reach the contract requirements are seldom or never repeated in the life of the boats. If these boats and their machinery were made more substantial, so that their full power could be exerted at any time and without risk, and the hull stand a moderate sea without danger, the 30-knot boat, by reason of the extra displacement, would drop to about 27 knots; yet we venture to assert that such a boat, ordered to reach a point at sea, say one hundred miles distant, in the shortest possible time, would reach the objective point in less time than the regulation 30-knot boat that is said to get a horse power in 50 pounds weight of machinery. A large proportion of naval vessels rated at high speeds, especially those over 20 knots, have obtained such speeds under conditions that cannot be reproduced when the speed is most needed, and a good, reliable, heavy-engined, 16 or 17-knot boat may outstrip them in a fight.

Whatever speed a fighting ship has ought to be produced when ordered from the bridge. An Atlantic liner would not be considered a success if in ordinary weather she could not cross the ocean at very near her trial speed, and if the machinery of a naval ship were as substantially built she could do the same if necessary as long as her coal held out. Merchant ships are now making the longest possible sea voyages with a steady and continuous production of steam greater than that produced per foot of grate in naval vessels in three, four or six hours forced draft trials that are said to be so destructive to boilers. In the merchant service machinery is built for full power as a normal condition. In the navy full power is only to be resorted to under great necessity, and maintained at a terrible risk, hence the difference.

Returning to the subject proper of this paper, we would propose for a torpedo boat destroyer adapted for service on the Pacific coast the following general characteristics as necessary to meet the conditions of the varied service required, the outline drawings accompanying this paper being illustrations of how we would embody these qualities in a sea-going vessel: Length on normal water line, 250 feet; extreme width, 25 feet; depth, moulded, 15 feet; draught of water on trial, 8 feet; draught of water loaded, 9 feet 5 inches; displacement on trial, 640 tons; total load displacement, 800 tons; indicated horse power on trial, 7,000; speed on trial, 25 knots; radius of action at 12 knots, 3,200 knots; best speed from San Francisco to Honolulu, 15 knots; best speed from San Francisco to Puget Sound naval station, or San Diego, in good weather, 20 knots. The weights provided for are as follows: Ordnance, 36 tons; machinery, including water in pipes and boilers, evaporating plant, tools, spare parts, water in water tanks, etc., 230 tons; hull, complete, and fittings, 300 tons; crew and effects, including portable furniture, 14 tons; coal at normal trim, 60 tons; making the normal displacement 640 tons and the coefficient at 8 feet draught .448. With bunkers full of coal there would be 160 tons added, the full coal capacity being 200 tons.

As will be observed by the outboard profile, we have designed this vessel to have a full forecastle, extending to the forward fire room, and a half poop extending to the engine room. Between the poop and forecastle a hammock berthing extends the full lengths. The 6-pounder guns, of which there are six, would be carried on rail mounts above the hammock berthing. This arrangement would give very good quarters, both for officers and crew. Casings around the two smoke pipes are carried up high enough to carry the inner ends of the boat skid beams. This enables four boats to be carried, while the casings furnish room for the galleys on deck. We propose to carry two 4-inch rapid-fire guns, one on the forecastle deck and one on the poop. The conning tower is of 1-inch nickel steel. There is a chart house aft of the conning tower, and a bridge above. There is also an after steering house on the poop. This covers the stairs to the officers' quarters and carries the search-light above. This light would be controlled from the forward bridge. The machinists would occupy a space at the forward end of the poop, entering from the landing leading to the engine room, aft of which would be the ward room and officers' staterooms. The total complement of officers and crew would be seventy-five.

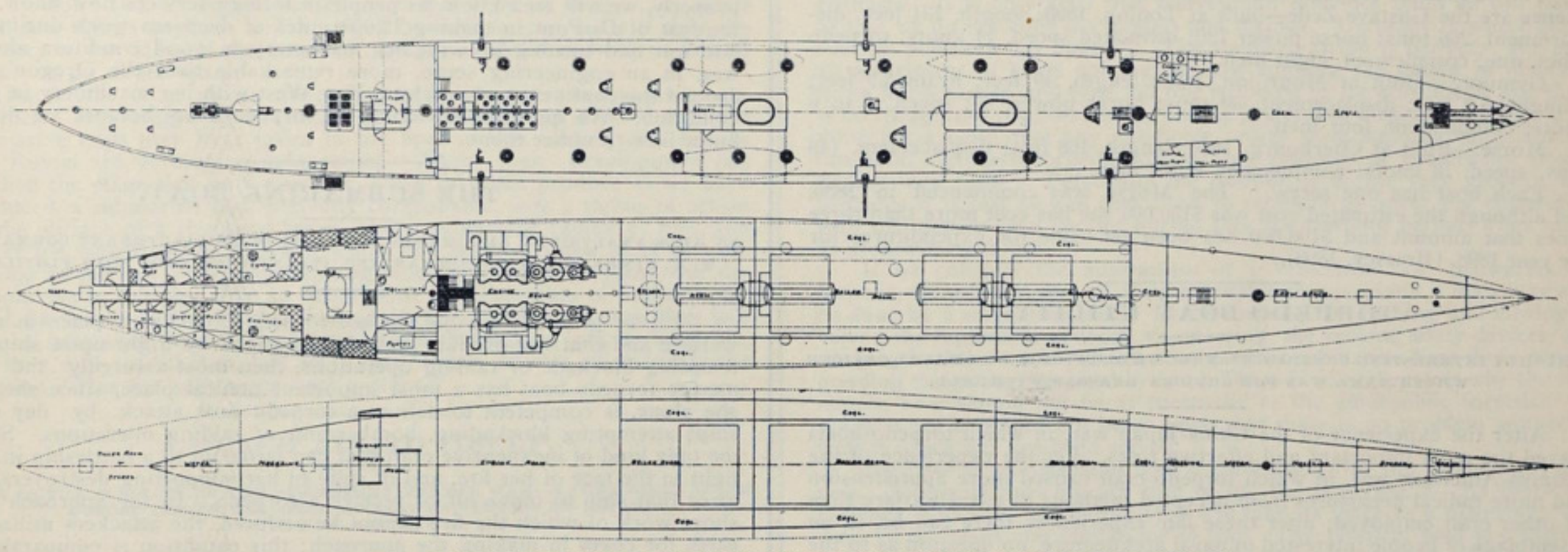
We have, in this vessel, purposely omitted all deck torpedo launching tubes, believing that they should form no part of the armament of a sea-going torpedo boat destroyer, as such a vessel must be prepared to go into action along with the fleet of which it forms a part, superior speed would



DETAIL DRAWINGS ILLUSTRATING THE PAPER BY G. W. DICKIE.

enable her to choose the kind of vessel with which she would engage. The deck tubes would, in such a case, if there was any intention to use it, contain a charged torpedo that would, in such an exposed position, be a constant source of dread to those on board. We have, therefore, arranged for two special submerged torpedo tubes in a protected compartment aft of the engine room. Owing to the limited width of the vessel, these tubes would be designed to open on top instead of at the inner end. We believe that there is no mechanical difficulty in designing the discharging tube and the impeller that carries the torpedo clear of the skin of the vessel before release, so as to admit of the torpedo being placed in the tube from the top side. The sloping sides of the torpedo room would be of 1-inch nickel steel. We have also provided 1-inch nickel steel protection extending the whole length of the engine and boiler compartments, so as to give a moderate amount of protection when the coal bunkers are empty.

We have shown four Thornycroft boilers in our design, and four-cylinder, triple-expansion engines of 7,000 horse power. We have allowed 30 tons extra weight for the machinery above that allowed for the same horse power in the usual types of torpedo boat destroyer, so as to have a fair margin of safety in all main parts of the engines and boilers. In this design our aim has been to produce a sea-going torpedo boat destroyer that can go to sea and remain at sea without any special risk, and at sea can maintain a speed of 25 knots for a few hours when such a speed is required; that can make extended voyages, thus serving the purpose of a scout or dispatch boat, whenever or wherever such service is required; that carries a battery that makes her a torpedo boat destroyer in fact. This boat would show better speed under regular service conditions than any of the so-called 30-knot torpedo boat destroyers, and for sea-worthiness, habitability or fighting capacity far outranks them.



DECK PLANS OF THE TYPE OF TORPEDO BOAT DESTROYER SUGGESTED BY G. W. DICKIE.

HOLLAND SUBMARINE BOAT.

CAPTAIN W. H. JACQUES OF THE HOLLAND SUBMARINE TORPEDO BOAT CO. PRESENTS A TREATISE ON THE CRAFT IN GENERAL.

In my paper on submarine torpedo boats read in London, last April, at the thirtieth session of the Institution of Naval Architects and in recent issues of a current magazine I have emphasized my belief in the value of submarine boats in warfare and given my reasons for thinking they will greatly influence the torpedo boat architecture of the future.

A careful study of the types experimented with for the past fifteen years has lead me to believe that the principles of the Holland type are the simplest and most easily controlled. You will remember that its fundamental principle is to dive, like the porpoise, and not to be controlled as in the foreign types, either by the inlet or outlet of water or by downhaul screws alone. This principle, combined with an unmovable center of gravity assures perfect control. The Spanish boat Peral is said to function well and the boats of the Morse type in France are much prized

by the French government. Of the other boats I have seen in addition to the Holland, the Nordenfelt gave the greatest promise.

Of torpedo boats I will say but a word. Recent events have shown that the high speed of the Spanish destroyers could not save them and that visibility makes them but targets to be riddled and cut to pieces by rapid fire ammunition long before they can get within range of their torpedoes. Millions of money are annually spent for fixed mines, controlled and automobile torpedoes, and yet we hesitate to provide for the construction of craft that not only comprise all of these elements but can also accomplish by their invisibility what torpedo boats have so signally failed to do.

Greater emphasis to the possibilities of torpedo success has never been given than by the destruction of the Maine. The failure to locate the responsibility is a tribute to the value of the invisibe cause. Had there been a submarine torpedo boat in Cuban waters at that time can any one doubt where the responsibility would have been placed? The submarine boat, therefore, if used only as a mine has the greatest advantage of mobility over immobility, perfectly filling the gap between the immobile defences and the perfect mobile ones by virtue of its being a moving mine combining all the terrors of the fixed mine with that of rapid change of location as circumstances require.

Summing up the situation, I believe, as I stated in London, that while importance should be given to designs that will utilize the semi-submerged principles, the great need of the hour for harbor and coast defence and especially for the new territory we have acquired, is a small torpedo boat that can be submerged, having within it a storage battery of sufficient power to give it a submerged range of a few hours, a surface speed of 9 or 10 knots and from 6 to 8 knots submerged. Referring to the commercial side of the problem will not the resultant value of the system justify less conservative estimate of the novelty of the invention and as great liberality in sharing the cost of experiment as was shown the auxiliary navy and transport supply during the recent war with Spain?

The submarine torpedo boats in addition to the Holland now in existence are the Gustave Zede—built at Toulon, 1893; length, 131 feet; displacement, 266 tons; horse power 720; estimated speed, 14 knots; torpedo tubes, one; complement, eight men.

Gymnote.—Built at Mourillon, 1888; length, 49 feet; beam 5.9 feet; draught, 5.9 feet; displacement, 30 tons; horse power, 60; speed, 4 to 6 knots; complement, four men.

Morse.—Built at Cherbourg, 1886; length, 168 feet; displacement, 146 tons; speed, 13 knots; complement, eight men.

Each boat has one screw. The Morse was commenced in 1886, and although the estimated cost was $150,000 she has cost more than three times that amount and $100,000 has been set aside for expenditures for the year 1898. (Brassey, 1898).

TORPEDO BOAT UTILITY.

A HIGHLY INTERESTING CONTRIBUTION TO THE DISCUSSION BY A NAVAL OFFICER WHOSE NAME WAS FOR OBVIOUS REASONS WITHHELD.

After the experience of the China-Japan war, in which torpedo-boats played the most important and effective roles, after the experience of the Spanish-American war, in which torpedo-craft caused more apprehension and more radical departures from accepted methods of naval warfare than all other craft employed; after these late experiences there can be, in an assemblage of people interested in naval architecture, no question as to the utility of torpedo-boats, considered as a general proposition. In all foreign navies worthy of the name, the tactical place of the torpedo-boat is well defined and the great usefulness of her enormous power within her limited field of work, is as well understood as are the characteristics of any other type of fighting craft; and yet we, the people of the United States, and we, the people of the United States navy, the majority of us, at least, do seriously question the utility of the type.

The reason for our unique attitude in this matter of torpedo-boats is readily understood when we contemplate the determining conditions in our country, all of which are more or less familiar to the members of this society, but a few of which I would venture to recall to your remembrance: First, we have never approximated to any policy in torpedo craft design or building program, as is apparent from a glance at the displacement column in the navy register; second, we have the vaguest notions as to design and requirements of torpedo-boat machinery as is shown by a comparison of the displacements and horse powers of our boats; third, we are at least fifteen years behind the civilized world in our ideas as to the conversation of the material of our boats, as is shown by our laying them up and hauling them out of water, a process that has long since been given up by people who have tried it, because they have found that nothing causes more rapid deterioration; fourth, we have only a small, very small, personnel competent to handle torpedo boats, and this small trained personnel we do not at present propose to increase, or even to utilize as a nucleus for the organization of the crews of the new boats that must soon be received from the builders and put in commission; fifth, we have only very few officers of the engineer corps competent to give experienced trained engineering supervision to those repairs on torpedo-boats, which are attempted at navy yards, and those few are rarely available for the duty; sixth, we have never attempted a real torpedo-boat attack drill, and consequently have no experiences to aid us in deciding upon the tactical value of the craft. This list of a half-dozen well known determining conditions of our torpedo-boat service could readily be increased three times by enumerating of other equally important factors in the case; but it would be idle to do so since the list as it is, gives ample reason for questioning of the utility of torpedo-boats in the United States.

I will venture the opinion that, in time, some of these conditions will be modified; it seems to me that they must be for the following reasons: first, if we are to ever have use for a navy of fighting ships we must have an efficient torpedo-boat service to supplement the fixed coast, defences, or our fighting ships will surely be deflected from their legitimate offshore work to the in-shore defense of our ports and coasts; second, from the extent and condition of our attackable coast, and from the fact that torpedo boats are the only craft (bar armor-clads) that can check raiding armor-clads, we should lead the world instead of lagging behind it, in the development of torpedo-boat efficiency. When these facts become sufficiently familiar we may begin to utilize the heterogenous lot of boats now built and building, and may then become impressed with the necessity of systematizing designs and types.

As we will never possess enough torpedo-boats to cover our extensive coast properly, we should strive to develop that design which will best allow our boats to concentrate at and work from any base temporary or permanent, between Eastport and Galveston, Texas. Such a design combining sufficient torpedo armament for use against ships, sufficient gun armament to give the boat a fighting chance against a hostile destroyer at night, sufficient speed, endurance and sea-going qualities, can readily be worked out upon a displacement of 120 to 150 tons; providing we bear in mind the facts that we must, for lack of shore bases, furnish depot ships, or floating bases for the support of the boats, and providing always, that we obtain a clear idea of what we intend the boats to do, and then try to learn how they should best be used for the intended purpose. The true base boat, the 100 footer that we have tentatively attempted to develop, is too much of a luxury for us to consider until a real torpedo-boat service has been established. The line of demarkation should be sharply drawn between the torpedo-boat intended primarily for the defence of ports and coasts against ships, and the destroyer primarily intended for the defence of ships against torpedo-boats,—between the boat of 120 to 150 tons and the destroyer of 400 to 500 tons.

It has borne in upon us in the navy that the only way to do good gunwork is to get the best guns and then learn how to shoot them; but we are apparently utterly unaware of the more important fact that the only way to do good torpedo-boat work is to get the best boats for our purpose and then learn how to use them. If the navy axiom "the only way to learn how to shoot guns is to shoot guns" be true, how much more then by the course of sufficient reasoning is it true that, the only way to learn how to use torpedo-boats is to use torpedo-boats, since the shooting of guns is so much simpler a matter to learn than is the proper utilizing of torpedo-boats. If in the future we shall learn to utilize proper torpedo-boats properly, we will then know, as people in foreign services now know, that the feat of DuPont in making 12,000 miles of deep sea work during the late war and turning up with her machinery in good condition after it, was, in an engineering sense, more remarkable than the Oregon's run around the continent and reaching Key West with her machinery in good condition. We question the utility of torpedo-boats because we do not know how to utilize them.

THE SUBMARINE BOAT.

AN ABLE ANALYSIS OF ARGUMENTS IN ITS FAVOR BY LIEUTENANT COMMANDER W. W. KIMBALL, U. S. N., COMMANDING ATLANTIC TORPEDO BOAT FLOTILLA.

If it be granted that the surface torpedo boat has a place in naval warfare and that her primary duty is the attack by night upon ships attempting blockade or raiding operations, then most assuredly the submarine torpedo-boat has a most important tactical place, since she, and she alone, is competent to deliver a torpedo boat attack by day upon ships attempting blockading, bombarding or raiding operations. She is the only kind of inexpensive craft that can move up to a battleship in daylight in the face of her fire, and in spite of her supporting destroyers, and force that ship to move off or receive a torpedo. In the approach on a shore work of which the fire cannot be endured, the attackers utilize the earth for cover in making the approach; this condition is comparable to the utilization of water for cover in the approach of the submarine boat upon a battle ship—she uses the most convenient cover against fire.

One of the most common remarks heard in discussion of the practicability of submarine navigation, is in the form of a dogmatic assertion that there is no use in going under water because one cannot see through water, but there is rarely heard an objection to going behind approach works because one cannot see through earth, since as land animals we are more accustomed to the idea of going under the surface of the earth than to that of going under the surface of water. If we could see through water submarine navigation would be simpler; but it is doubtful whether the possession of such a power would make for greater efficiency in a submarine torpedo-boat, since the advantage due to the enlarged horizon would be counteracted in great part, by the loss of the perfect invisibility which she now possesses. This perfect invisibility must to be sure, be given up from time to time when the boat rises to observe the direction of her object of attack; but anyone seeing the few inches of conning tower of a submarine boat appear for the few seconds necessary to observe the object and correct the course, is impressed by the fact that she is always practically invisible when considered as an attainable gun target.

And this leads to the question of, why not use an awash boat and armor the conning tower? Why dive at all? The reply is that the awash boat could be readily sunk by destroyers, although she would have little to fear from gun fire, while the submarine could dive below the plane of the destroyers' torpedos, no matter what that plane might be; in other words she could move in a world of three dimensions, instead of in a world of two, as do the ships and destroyers, and therefore could not be prevented from ignoring the destroyers and holding for the ship.

An inexpensive boat with a crew of five that can within a limited field, prevent operation attempted by an expensive battleship with a crew of some hundreds, surely has a tactical place in naval warfare. A second, but very important use of the submarine boat, lies in her capability to attack shore fortifications within short range of deep water, and to enter fortified harbors and destroy ships, dry docks, or other property by means of aerial torpedoes; and a third is her capability of countermining a mined channel by towed countermines. Of the second use it may be truthfully said, that aerial torpedoes are not entirely effective against fortifications as was lately shown at Santiago; but it is to be noted that, at Santiago, the aerial torpedoes did ten times the work of a gun bombardment at a hundredth of the cost, and that consequently the besiegers using aerial torpedoes at a few hundred yards range from submarine boats, can, in that way, offer the besieged far more inducement to capitulate, per dollar expended in inducements, than in any other way at present practicable. Of the third use it may be said, that no countermining under covering batteries can be truly effective; but, even so, the submarine could accomplish

more than any other known device at much less expense in material and personnel.

The well known definition of strategy attributed to the late General Forrest, "Gettin' thar firstest with the mostest," has been paraphrased for tactics in "making the mostest with the leastest." If this definition applies and if we throw aside the second and third uses mentioned, there will surely be a tactical place for submarines, since, in their presence, blockades cannot be effected or bombardments attempted. To any one familiar with the many ridiculous torpedo boat scares in our fleets on the Cuban coasts, it would seem that there would be an attractive effect on Morale in the sighting of a submarine conning tower, as shown by the boat now in this harbor, or even in seeing a lot of dummy conning towers set adrift on the tide.

From all the foregoing it would appear that there is an important tactical place for the submarine boat, provided submarine navigation is practicable, from physical and moral points of view. That there is no physical difficulty in the problem is well known to all the members of this society, since they are fully aware of the fact that thousands of submarine boats are in use in all parts of the world to-day, in the shape of automobile torpedos, which are nothing more or less than automatic submarine boats. That the placing of a directing brain in a submarine boat, instead of the directing automata, does not increase the difficulty of the problem, is amply proved by the accurate functioning of the boat now in this harbor, which has shown to scores of doubters that perfect control in both the vertical and horizontal planes has been accomplished, that the boat can be held at any depth to within a foot, can be made to take porpoise-like dives exposing the conning tower for only six or eight seconds, and can be steered on any desired course.

But the moral difficulties are the great obstacles. In the navy we don't like the idea of going under water; it is uncanny; of the sixty or eighty submarine boats experimented within the last hundred years, one has drowned her crew; and therefore we consider such craft dangerous; and we don't like to expose ourselves to that kind of danger; we don't want new things anyhow, and we won't have them, especially if they are contrary to our ideas of the fitness of things; we don't consider it fit and proper to go under water.

But in the other navies there is much less prejudice against submarines. The foreign naval attaches in this country are pleased with the submarine trips they have taken in the boat in this harbor, and France and Russia are developing submarines. When their development has reached the stage that ours now has, when they can produce as we have produced, a submarine boat perfectly controllable, with a radius of action on the surface of a thousand miles, and a submarine radius of fifty, the power for which can be renewed within the boat, as often as is desired, so long as the fuel for surface running holds out—when, in short, our developments in this line, like so many other developments of military material, have been rejected by us, and adopted by foreign services, they will put the submarine boat in the tactical place that has so long awaited her, and then, and not till then, will we in this country answer affirmatively the question, "Has the submarine boat a place?"

A PLACE ALL TO ITSELF.

SUCH IS THE POSITION OF THE SUBMARINE BOAT IN WAR—MAKES BLOCKADING ALMOST IMPOSSIBLE—THE SUBJECT AS VIEWED BY LIEUT. A. P. NIBLACK, U. S. N.

The torpedo boat has not many friends in the United States, either in or out of the navy, and this, too, in spite of the recent improvements in torpedoes, by which their efficiency has been increased at least 100 per cent. The Obry attachment has made possible an absolutely safe and accurate underwater discharge, as well as a deadly accurate discharge. We have no torpedo boat history. Other countries have gradually developed a system. We have jumped into the middle of it. We are beginning at the top, and our policy is very unstable and wobbly, because nobody really knows very much about them. Many very estimable people think they go under water.

During the war this summer it was found necessary to use the torpedo boat on dispatch and blockading duty. No one can deny that most of them did their duty well, considering that they were not designed originally for that purpose. We are not willing to accept the lessons taught us in Europe, where everything is worked out thoroughly, and where all we have to do is to read and learn. We must have our own costly experience, and we are calmly proceeding to make every mistake possible, and in four or five years, we will be where some navies are now, but with our methods we will always be behind. The outlook is not encouraging. We have almost no trained officers or men. Many new boats will soon commission to go into the hands of everyone untrained. Some pressing necessity has driven the Department to putting all our boats out of commission. This means not only a loss in training, but a deterioration in material, because the method of laying up is open to the objection that it is contrary to accepted methods abroad. Even if it is successful there is no need to experiment.

In Norway, Sweden, Denmark and Austria, boats are hauled out of the water under sheds in the winter season. In the northern countries it is on account of the ice, but more especially because there are no crews available as conscription is only for six months in other than the winter season. In Austria all the boats are at Pola and in winter are hauled out under sheds only because of the heavy gales and because money is not available to construct a basin in which to moor them. The Austrian officers disapprove of hauling boats out. They say it causes a loss of speed to the boat of from one-half to one knot each time it is done, and injures the hull and machinery. Of course we may be able to haul our boats out without injury but the cold will hurt them. In Germany the boats stay in the water always except when periodically docked or under repairs. In winter steam heat is kept on them constantly, the steam heating pipes being connected with a boiler on shore, or else to an old torpedo-boat or hulk used only for this purpose. They regard a torpedo boat as a delicate instrument, and yet they go to the extreme of sacrificing speed to strength. Their boats are all single screw, but they have a bow rudder in addition to the after one, which makes them handle as well as a twin screw boat. The bow rudder may be raised or lowered at will.

Even with our twin screw boats such a rudder would be most acceptable. Boats in commission in Germany are available for war in the time it takes to coal and provision and get a few explosive fittings carried only in war (for countermining, etc.). Boats in the first reserve have their men and all stores aboard except war heads and explosives. The crews live on board station ships adjacent, and boats of the first reserve are ready for war in six hours. Boats in the second reserve have their stores in an immediately adjacent store house. Each boat has its own separate building. They can be ready for use in forty-eight hours, or in time it takes to call in the crew from civil life. All fittings of boats are absolutely standardized, and in the group built at the same time the parts are interchangeable. Their store system is ideal. We could never approximate to it in a hundred years, and we are getting away from standardization as rapidly as the different private firms can drag the navy department into permitting it. Our steps are all rapidly backwards. Our store system is so onerous that in putting the Winslow out of commission some days ago, and having unusual assistance in trying to make a record, it took seven days to lay her up. I have no idea that in April, when the boats are to re-commission they will really be ready for sea inside of a certain number of weeks, and with all the care given to the engines in the way of red and black lead, tallow and vaseline, I doubt if they can be put in running order short of several weeks. Meanwhile, in case of war, where are we? Of course there is no danger of war. There never is until it comes.

It has been my personal good fortune to see practically every torpedo-boat in four or five foreign navies and to study the various types somewhat superficially. I unhesitatingly give it as my opinion that the DuPont and Morris, built by Herreschoff, are the two best boats of their type in the world, and that there are very few poorer ones than the Foote, Gwin, Rodgers, Winslow, and Ericsson. Herreschoff is as much a master in boat building in general as Edison is in the field of electricity. The engines of the DuPont are as distinctly superior to those of the boats above mentioned as a Blake pump is to a handly billy. I don't say this in criticism. It is only grief that Herreschoff does not build all our boats, or that we do not copy his models and fittings. Germany is where she is because Schiehan has built all. The standardization is perfect. We have an assortment of boats coming on now running the gamut in displacement, horse power, and type, till one is forced to the conclusion that there is no recognized relation between horse power and displacement, nor anything but a belief that any one-horse power shop building establishment can build a modern torpedo boat, or any engineer or constructor design engines and hulls. Personally the outlook is to me very gloomy, and probably it is just as well that I am to temporarily sever my connection with the torpedo boat service during this, the teething period, when all of us are learning things.

If we consider the mechanism of a Whitehead or Schwartzkopff torpedo, we will find that all the remarkable things which it does may also be done by a submarine boat. In the torpedo the opening and closing of valves, the regulation of depth, the steering, the various safety devices, and the length of the run are all automatic. In a submarine boat these corresponding things are regulated by hand. There is no real reason why the submarine boat should not be as successful as the automobile torpedo. Its speed is not and need not be so great, but there is no problem connected with it which has not been solved.

We have in the Holland boat a combination of the elements of success. Along its lines we are sure to get the best results. As more experience is had the submarine boat will take its place as a disturbing element in the plans and operations of war. The Holland boat is a distinct success, and I hope will be purchased by our government. There is one difference between a submarine boat and a torpedo, which is very important. In the torpedo all gearing is oiled automatically, and a torpedo may lie idle six months or more, with no deterioration. With the submarine boat the care of all the rather delicate apparatus or mechanism must be unremitting and tireless—much more so than in a torpedo-boat, which is difficult enough. There is another feature of submarine boats in general, which has to be considered. If a propeller fouls a buoy rope or chain or mooring when the boat is under, it is "all up" with the crew, because there is no way of getting out to clear it. I understand that in the boat building at Baltimore, the government requirements were so difficult that it was necessary to give her five propellers—five vulnerable points, and five chances for trouble. No one can blame the designer for this, but the propeller question is easily solved by having as few as possible and having those guarded. I made a trip in the Holland boat, and everything worked perfectly. The sensation of diving is a little unusual—otherwise it is rather tame sport compared with a torpedo boat at high speeds. There is no reason to consider the submarine boat as dangerous. It can be made almost absolutely safe. Indeed in war it has many more chances than a torpedo boat, but its crowning virtue is that it makes blockading almost impossible, and strategically in war has a place all to itself.

FAVORED TORPEDO BOATS.

W. L. RODGERS OF THE WASHINGTON NAVY YARD DID SO IN A PAPER CONTRIBUTED TO THE DISCUSSION OF THE SUBJECT.

In the recent war the Spaniards were unenterprising, and the Americans had no opportunity, so torpedo boats did not use their torpedoes, and the public seems to have jumped somewhat hastily to a conclusion that the war has discredited these crafts. One might as well think that armored cruisers are discredited because the Spanish ones accomplished nothing. In order to show how erroneous are the opinions now popularly current in regard to torpedo craft, the nature of the torpedo must first be understood as well as the limitations which its characteristics impose on the employment of the boat; then the boat itself may be considered.

Before going further I would like to call to mind a fact which naval architects to frequently overlook in discussing naval design. This is that mechanical and architectural improvements are valueless unless they confer desirable, tactical, or strategic advantages in due proportion. This observation applies with particular force to the question of speed, of which the importance seems to be overestimated on many occasions. Perhaps this is because of all nautical and tactical qualities, speed alone can be measured absolutely. Thus in the consideration of rival designs it appears

with singular advantages over other features, whose tactical importance is not less, although less easily demonstrated. But to return to the torpedo. Briefly the torpedo is an automobile submarine boat, weighing 850 pounds, and carrying a cargo of explosives. It is launched by a very small powder charge, and in launching it takes a deep initial dive, after which the depth regulating gear brings it to the desired depth. Until recently it has been without inherent directive force, and its course, after discharge was influenced by the speed of the boat firing it, as well as by the chance of the wave surface as it enters the water. Its maximum speed has been 30 knots, and its speed at that range about 400 to 500 yards and less at greater ranges. Now note how all these peculiarities affect the tactical employment of the torpedo boat. First, although the boat runs at a depth of from 5 to 15 feet, it dives deeper than that when leaving the boat, and there is risk in hitting the bottom in less than 30 feet, the risk increasing with diminishing depth. Thus the torpedo cannot be fired when the boat is in shoal water. Then rough seas make its course erratic, although a new device, soon to be issued to our service, diminishes this source of error. Finally the speed of the torpedo is not superior in any great ratio to that of ships, so that the man firing must make allowance for the speed of the target at the instant of discharge. An error of only two or three knots in his guess will cause a considerable displacement of the torpedo on the target. At 500 yards range an error of three knots in his guessing the speed of the enemy will cause the torpedo to miss a 300 foot ship. Thus the boat must be within 400 yards before she can begin to fire with any reasonable expectation of success. At the same time the commanding officers will feel disposed to fire the instant the enemy opens, on the ground that a chance shot at long range is so much, and if one waits for closer range the torpedo may never be fired at all.

Taking up the subject of the boat itself we have great engine power in a small displacement, and consequently machinery so light and frail that after every hard run it is necessary to lie by for a little while and tune up again. Moreover, the quarters for the men are small, and hot in summer and cold in winter, making life impossible for long periods of active work. Those who maintain that men can become accustomed to the service lack experience. It is simply impossible for a crew numbering only twenty men to maintain itself on blockade duty for long periods in a torpedo boat without gradual deterioration of health, and a large sick list following any unusual exertion. A minimum crew of thirty-five to forty is needed for continuous service. Further it must be recollected that owing to their small size torpedo boats cannot maintain their nominal speed except in the smoothest seas. A gale which would cause a great Atlantic liner to slow down one or two knots would make the DuPont slow from 20 to 25 knots below her mail speed.

The field for torpedo boats is clearly indicated by these considerations. Properly the boat is almost as purely a weapon for coast and harbor defense as a gun mounted on shore. Although it is possible to use it for distant service, it should be kept in port, ready to rush out upon an attacking enemy when circumstances are favorable. But the fate of the Spanish boats at Santiago and San Juan show that a day attack is almost hopeless. The torpedo boat should therefore be small enough to depend largely upon invisibility at night. As for speed it should not be excessive, but we should seek rather somewhat greater solidity in the machinery, especially in the auxiliaries, together with boilers giving steam somewhat excessive for the engines. All machinery, I think, should be in duplicate, including boilers, engines, all auxiliaries, and also the main steam piping. All auxiliaries should be independent of the main engines. Twin screws are desirable for the sake of reduced draft, and precision of manoeuvering, although the single engine has certain good points. As for speed it seems to me that 22 to 23 knots, or that of the fastest cruisers is ample. Any greater speed can so seldom be used on the open sea, that it is not worth the necessary sacrifice. Upon this point it must be recollected that in delivering an attack by night or in thick weather, a speed of 10 or 12 knots only would be used. Greater speed might cause a marked bow wave, and occasional flame from the smoke-pipes, or noise from the blowers; all these are objectionable. Full speed will probably not be used until the retreat, and then it is not very important, except personally to the people on the boats. This at least was the consensus of opinion among the commanding officers of our boats during the late war.

I think the Morris and Cushing may be taken as the type of the best class of torpedo boat, although the former, I am told, rolls excessively. They have sufficient speed, and are seagoing boats for use from a local base. Smaller boats such as the Salbot have not sufficiently great sea going qualities, and only single engines and boilers, so that they are of little utility; still in quiet summer weather they might do service.

I cannot doubt for an instant that the field for torpedo-boats in the way of local defense is a most important one. It is unfortunate that the lack of positive results this summer has led the general public to believe that they have been over-rated, but I feel sure that this is not the idea of the navy. On the contrary it is scarcely an exaggeration to say that the Spanish destroyers were as much dreaded as the big ships. Only the singular apathy of the Spaniards prevented them from making good use of their fine boats. In fact the torpedo-boat stands just where it did before the war began. It is a weapon with great possibilities, but its capabilities are not yet definitely known. Therefore its moral powers will be very great until we have a fuller record in regard to it, and for this reason it must not be neglected at present. On the contrary the element of doubt about it adds very much to its effectiveness, if it is known that the enemy intends to use it boldly.

The torpedo boat destroyer is the tactical reply to the torpedo boat. She is of exactly of the same type, but larger, faster, and with a good battery of light guns in addition to her torpedoes. She must be able to accompany the fleet and remain at sea with it when it blockades, in order to keep off the hostile torpedo boats. Invisibility is no longer a disideratum and she must be sufficiently high forward to be a good sea boat, and to afford fairly comfortable quarters for a large crew. The engine room force should be large enough to stand in three watches, and the fire-room force should be in three, with an extra watch to take day's duty in overhauling boilers not in use, running distillers, and for other extra work. The deck force necessary for manning the guns will be more than enough for the three watches at sea.

Speed should be greater than that of torpedo boats, but not excessively so, as the larger boat has an advantage in rough weather in proportion to her size. Thirty knots is ample speed for a destroyer, and personally I should prefer a somewhat less speed say 28 knots with somewhat heavier machinery and large boilers, and the duplication of parts, including main steam-piping. The duty of such boats will be to act as despatch boats and scouts. When on blockade they will take the inner line, allowing the heavy vessels to lie well out every night. When two hostile fleets meet, it is probable that a general fleet action will be preceded by a combat of destroyers, just as on shore, the cavalry forces feel each other and engage before the main bodies. There should be no boats whose size is between that of Morris and the large destroyers. Money spent in such vessels is not well invested, no matter how fine they may be in design and workmanship. The reason is that the medium size boats such as the Foote and Porter, are not quite big enough to keep company with the fleet, while they are larger and therefore more expensive than is necessary to act from a local base. As the utility of torpedo boats is under discussion it may be interesting to point out why the late war threw so little light on the question.

The principal Spanish naval forces were concentrated at Havana, Santiago and San Juan, and included torpedo-boats or destroyers at each place. Our forces naturally were concentrated in front of the Spaniards. At each place the opportunity of the Spanish boats was ideal, and their failure to accomplish anything is owing entirely to the singular lack of initiative, which was the universal Spanish characteristic both ashore and afloat. As for our boats there was nothing for them to attack except at Santiago and Havana, at both of which places, floating obstructions rendered it impossible to rush through the entrances, while their narrowness, and the presence of machine-guns and infantry rendered it hopeless to attempt to remove the obstructions, and then proceed on. In these circumstances it seemed that torpedo boats might do useful general service in blockading and despatch service, and they were so employed. That they were not well suited for such service is evident, but nevertheless they were of more or less use, and in default of proper work for them it was wise to make them do what they could, no matter at what cost to themselves.

ANOTHER LAKE PASSENGER STEAMER.

Chicago, Nov. 16.—The freight and passenger steamer for which the Northern Michigan Transportation Co. has just closed a contract with the Chicago Ship Building Co. will be a first-class vessel in all respects. She is to be delivered about June 15 next. It is claimed for the new boat that she will be the fastest single-screw freight and passenger steamer on fresh water, and in point of comfort and elegance of equipment will be equal to the best craft on the lakes. She is to have a guaranteed speed of 17 miles an hour. With forced draft this may be increased to 18 miles, and perhaps more. Her cost will be in the neighborhood of $250,000. The new steamer is scheduled for three round trips a week between Chicago and Mackinac island, stopping at Charlevoix, Harbor Springs and Petoskey. This is in direct competition with the Manitou of the Lake Michigan & Lake Superior Line. The steamers Charlevoix and Petoskey will be continued in their present schedule for Northern Michigan points, and with the new boat the line will give a daily sailing from Chicago for Harbor Springs, Charlevoix and Petoskey during the summer. Accommodations will be provided for 200 persons in the staterooms, and provision will be made in addition for 800 tons of freight. Cabins will be finished in birch with mahogany trimmings, and hot and cold water will be piped to all staterooms.

In general appearance the new ship will not be unlike the Virginia of the Goodrich line, as that boat will come out in the spring, for both craft will have a tier of staterooms on the hurricane deck. Dimensions of the new boat are: Length over all, 240 feet; beam, 40 feet; moulded depth, 16 feet; draught, 12 feet. Engines will be triple expansion, the cylinders measuring 20, 33 and 54 inches diameter, with a common stroke of 36 inches. Boilers will be of the Scotch pattern, two in number, 14 feet long by 11 feet 6 inches in diameter, and allowed 175 pounds working pressure. The engine will develop about 1,800 horse power. There will be two dynamos, each with its own engine, and carrying a total of 500 electric lights. A large searchlight will also be provided. The construction will be steel as far as possible, even to the decks. The hull will be subdivided into six water-tight compartments.

"We have designed this boat to meet the popular demand for the very best in the lake passenger service," says Manager E. W. Seymour. "We are sparing no pains to make her a perfect passenger ship, and Mr. Babcock has given every detail in the plans his careful attention. We will have a safe ship, a comfortable ship, and a speedy one, and she will not be an ugly craft, either."

In a letter to the Review, one of the officers of the Falls Hollow Staybolt Co., Cuyahoga Falls, O., refers to an order which his company has just received from the Calumet & Hecla Mining Co. for 3,000 feet of their safety staybolts. "We are building up quite a large trade," he says, "with manufacturers of marine boilers for our staybolt iron. Requirements of the United States steamboat inspection service are such as to make our bolt, which we consider much cheaper and better than a drilled or punched bolt, particularly desirable in marine boilers. In every case where we have had an order from a manufacturer of marine boilers, we have secured a regular customer. Several orders received recently are from Japan."

It often happens that owners or managers of vessels are desirous of taking up the study of certain features of hull construction, of special parts of machinery, or of electric lighting plants, for instance. John Wiley & Sons of 53 East 10th street, New York, well known to marine engineers and naval architects throughout the country, make a specialty of works of this kind. One of their catalogues contains the names of several hundred books, all standard works, covering a very wide range of subjects of a marine kind.

A new catalogue of liquid compasses and nautical instruments from E. S. Ritchie & Sons of Boston, Mass., is at hand. It is, of course, interesting. There are on the great lakes more compasses of the Ritchie kind than all other makes put together. The sale of Ritchie compasses exceeds 24,000.

POOL METHODS IN ELEVATOR.

THEY ARE GRADUALLY BEING OVERCOME AT BUFFALO—SITUATION AS REGARDS UNLOADING OF VESSELS NOT VERY SERIOUS AS YET.

Buffalo, Nov. 15.—The local grain trade has scored another victory that has a bearing on the elevator problem and will therefore prove interesting to vessel owners. The elevators of any port, if they are to attempt pooling, should be pooled as to the handling of cargoes as well as in regard to rates. With this arrangement in force, there could be no delay in unloading grain cargoes till all the houses were filled, or at least all that are able to deliver the grain as desired by the shipper. When the coming struggle for more rational handling of the room in our elevators is entered upon by the united vessel interests, this point should be insisted on as fundamental. Till this season the elevators in Buffalo harbor have been pooled to hold rates and save the expense of keeping accounts, but there has been no arrangement whatever in the interest of speedy handling of cargoes by the exchange of room in the elevators, a most necessary scheme in case there is a disposition to bunch cargoes, either by accident or design, when business is brisk.

But to the story. A short time ago a Buffalo grain dealer bought a lot of oats of a Chicago house through Buffalo agents and sold them to parties down the line of the Lackawanna road before the cargo arrived. It was, of course, necessary to have the grain unloaded into an elevator that had Lackawanna connections, so the buyer ordered the grain into the Wells elevator, which stands on the Lackawanna track. The grain came consigned to the New York Central elevator and the buyer was not able to change the destination. He telegraphed his customers and was informed that they positively could not use grain over any other line than the Lackawanna, so the dealer threw up the deal and made a demand on the agents for $275, which he claimed he had lost through the failure of the sale. When they failed to respond he entered a complaint against them before the Merchants' Exchange. That body, by its reference committee, promptly discharged the Buffalo agents as entirely innocent of the consignment of the grain to any particular elevator and addressed the Chicago house direct, demanding the payment of the money lost. The Chicago firm, of course, demurred, but the Exchange was firm and promulgated this ultimatum, that unless the claim was met the Chicago house would be debarred from selling any more grain on 'Change here, either direct or through agents. The firm then agreed to pay the claim.

This may seem a harsh ruling at first thought, but it is for all that a step in the right direction. It says in so many words that the buyer of grain to arrive is the owner of it on arrival and must be allowed the control of it. It establishes a precedent that will go far towards straightening out the kinks of the "one elevator or nothing" system. If it should be carried a step further, so that the consignee could be held in the same way, there woul be still more gained for the vessel in the traffic. As it has been, the elevator was selected in Chicago or Duluth, and no matter how many times the grain changed hands on the way, the elevator designated usually sought to hold the grain.

Another case of note has arisen within a week. The steamer Elphicke had in her cargo about 41,000 bushels of grain that nobody claimed. The agents of the vessel, after failing to discover the owner, put the grain into an elevator of their own selection and held it for the freight.

Mr. A .B. Wolvin of Duluth does not wait long for an elevator. A small lot in the last cargo of the Superior City was "hung up" by consignment to a house several days behind its business. He ordered the grain put into another house and the steamer was soon going up the lake. The owners of the grain settled for the freight. It may be said in passing that if all vessel owners had some of this backbone we would not have the spectacle of vessels waiting day after day for elevation and lying right alongside of an elevator that is idle and practically empty. It ought to be said also that Mr. Wolvin has more at stake than most vessel owners. All of his Zenith City vessels are capable of carrying a matter of 200,000 bushels of wheat at a cargo, and to wait for elevator means something. It was this same cargo of the Superior City, if I mistake not, that netted $7,200.

The elevator situation, taken as a whole, is not very serious as yet. Most of the cargoes are handled promptly, but this does not save some boats from lying three and four days waiting for an elevator. The 30,000 bushels in the steamer Vail, that was forced into an outside elevator by the vessel owner some weeks ago, will precipitate a fight, no doubt, as the owner of the grain bonded it and it has gone forward, leaving the bonds in the hands of the vessel owner as surety for the freight, if he comes out best.

THE LAKE-ATLANTIC FLEET.

Another of the lake barges bound for the Atlantic coast, the John O'Neil, chartered by C. R. Jones & Co. of Cleveland to the Atlantic Transportation Co., is wrecked. Owners of the O'Neil are advised that she is ashore on Prince Edward island, and it is more than probable that she will prove a total loss. Alike to the steamer Porter, sunk in the St. Lawrence river some time ago, she was fully insured through Johnson & Higgins, insurance brokers. The Porter was not, however, one of the vesssels chartered by the Atlantic company. She was engaged by the Manhattan Steamship Co. of New York, to be operated with three or four other small steamers on a short line that offers opportunities in general freight traffic. Her insurance, about $42,000, was considerably above the price at which she might have been purchased by the charterers.

Of some forty vessels chartered by the Atlantic Transportation Co., there are ten still above the St. Lawrence rapids which have been laid up for the winter. These are the Joseph Wall, Shawnee, H. W. Sage, Wm. McGregor, R. Halloran, M. W. Paige, S. H. Foster, Helvetia, J. H. Rutter and Metacomet. The reason given for not taking these vessels down the rapids is that the underwriters refused to insure them after Nov. 1. On this score the Atlantic company is negotiating with owners of the vessels with a view to having the charters extended for fixe or six months after the expiration of the three-year period, the owners to receive no payment for the next few months in lieu of this extension. This is a matter that will probably require concessions on both sides before it is settled. Several of the Atlantic company's fleet have already arrived at Newport News, among them the F. L. Watson, M. S. Bacon, T. P. Sheldon and F. A. Georger.

WORK ON ST. LAWRENCE CANALS—THE AMERICAN PROJECT.

Detroit, Mich., Nov. 16.—Interest in the completion of Canada's St. Lawrence canals has increased since the transfer of a large fleet of light-draught vessels from the lakes to the Atlantic seaboard. Mr. Geo. Y. Wisner, member of the United States board of engineers, who are working under act of congress on surveys of deep waterway routes from the lakes to the Atlantic, recently went over the Canadian canal routes along the St. Lawrence. "The Canadian authorities expect," he said in conversation with your correspondent, a few days ago, "to have the enlargement of the Galops, Morrisburg, Farrans Point, Cornwall and Soulanges canals completed by about midsummer next year, so as to be able to pass vessels of 2,000 tons through from the lakes to the sea. The effect of this water route on lake commerce may throw some light on the probable value of a deeper waterway from the lakes to the Atlantic."

Referring briefly to the work of the deep waterways commission, of which he is a member, Mr. Wisner said: "We have pushed the field work as rapidly as possible, in order to have all outside work completed this year, and have data in shape for the board to utilize for a general study of the problem and for plans and estimates. With the exception of borings to determine the character of the sub-strata through which the canal will have to be cut, the surveys of the Niagara route and the Oswego-Mohawk route have been completed, and those of the St. Lawrence-Champlain route will be finished is about a month. It is probable that some of the boring work on the St. Lawrence may have to go over to next spring, but generally speaking, we expect to have more of the field work done this year. Owing to the lateness of the season before appropriations were available, the survey of the foot of Lake Erie and head of Niagara river has not been finished in time for us to make a report on the regulation of Lake Erie this year, as we had hoped to do." u

D. Kahnweiler died at his home in New York on the 12th inst. The name Kahnweiler in connection with life preservers, life boats and life rafts has been familiar for a great number of years to everybody in marine lines. Mr. D. Kahnweiler was the founder of the well-known New York house that bore that name. His sons have of late years conducted the business.

TRADE NOTES.

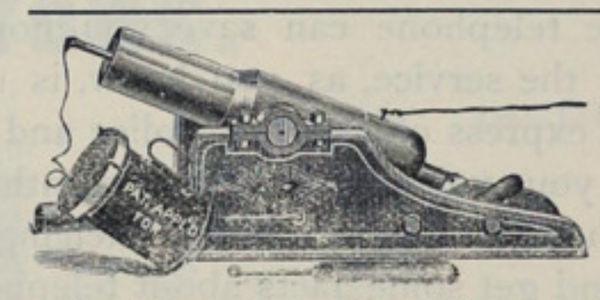
The Kenney Co., 72 and 74 Trinity Place, New York city, report that the government inspectors, after a thorough investigation, have decided to equip the transport Massachusetts, now being overhauled at the John N. Robbins Co. ship yard, Erie Basin, with the Kenney flushometer system. Sixty-nine Kenney flushometers were recently installed on the transport Mohawk and their selection for the Massachusetts is a flattering endorsement of the claims of the manufacturers. The flushometer is an ingenious appliance for flushing water closets and does away entirely with the noisy and otherwise objectionable overhead flush tank. It marks a distinct advance in sanitary engineering and marine plumbing.

One of the officers of the Standard Brass Works, an old and substantial concern of Kalamazoo, Mich., says in a letter to the Review: "We furnished recently to one boat builder more than 12,000 pounds of brass and bronze work and we are sure we can satisfy other people in marine lines who may want material of this kind. We make all kinds of castings in aluminum, brass and bronze lines—any grade of bronze—for boat and engine builders. We give special attention to phosphor bronze castings for engine (gasoline, vapor and steam) bearings and for propeller blades and wheels for small pleasure craft. We will be pleased to quote prices upon receipt of samples or patterns."

After doing business for forty years at 19 Bromfield street, Boston, the firm of Thos. Hall & Son, manufacturers of megaphones, will remove to 79 Franklin street. This firm suffered the loss of almost everything contained in their shop by fire on Sept. 16. The new quarters are more commodious and have been fitted up with new machinery, and are so arranged as to greatly increase the output of the firm.

The past season has been a prosperous one for Messrs. Wilson & Silsby, Boston sail makers. In May last they turned out 120 suits of yacht sails and have been very busy during the whole season. They have filled a large number of orders for lake yachts and lately received orders from New Zealand and Hawaii. They anticipate enlarging their quarters on Atlantic avenue during the coming winter.

Students desiring to go home to spend the Thanksgiving holidays may secure special concessions by calling on agents of the Nickel Plate road. 270



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PARTICULAR ATTENTION GIVEN TO SAILS FOR RACING YACHTS. ALSO THE OUTFITS OF LARGE STEAM YACHTS.

SEALED PROPOSALS will be received at the office of the Light-House Engineer, Detroit, Mich., until 12 o'clock M., Nov. 21, 1898, and then opened, for furnishing the boilers and machinery for four complete steam fog signals, in sets of two, being two complete sets, or alternatively, for two sets of boilers in duplicate without engines, etc., delivered at the Light-House Depot at Detroit, Mich. Plans, specifications, forms of proposal, and other information may be obtained on application to the undersigned. M. B. Adams, Lt. Col. of Engineers, U. S. A. Nov. 24.

SEALED PROPOSALS will be received at the office of the Light-House Engineer, Detroit, Mich., until 12 o'clock M., Nov. 28, 1898, and then opened, for furnishing the boilers, machinery, etc., for four complete steam fog-signals, in sets of two (being two duplicate sets) delivered at the Light-House Depot, Detroit, Mich. Plans, specifications, forms of proposal, and other information may be obtained on application to the undersigned. M. B. Adams, Lt. Col. of Engineers, U. S. A. Nov. 24.

NOTICE.—The steam pile driver "FISHING QUEEN", owned by John W. Averill, Jr., burden about 7.91 tons, together with boilers, machinery, anchors, cables, furniture, tackle, and all appurtenances, will be sold from the west steps of the Post Office Building, Cleveland, Ohio, on Tuesday, November 29, 1898, at 10 o'clock, A. M., to satisfy an indebtedness of $7,700.00 of the National Bank of Commerce of Cleveland, Ohio, against said John W. Averill, Jr., under a certain mortgage, recorded Book 71, page 72, Office of Collector, Cleveland, Ohio. SQUIRE, SANDERS & DEMPSEY, Attorneys for National Bank of Commerce of Cleveland, Ohio. Nov. 24.

FOR SALE—STEAM BARGE and CONSORT.

STEAM BARGE classes A 1*; capacity, 600M feet of lumber, 33,000 bushels of Wheat or Corn, 900 tons of ore; light draft; in good condition.

CONSORT classes A 2; capacity on 12 feet of water, 850 tons of ore, 32,000 bushels of Grain, 700M feet of dry lumber. Good trade will be offered. Address

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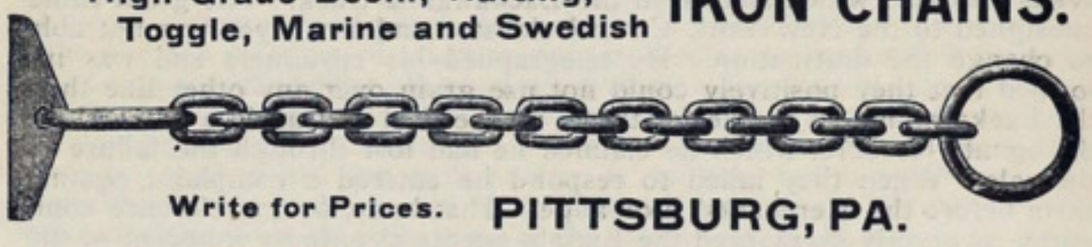

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$1.50 PER MONTH.

For your residence, the telephone can save you money and take care of your household needs as it does of your office business. And the service, as you know, is unexcelled. Your doctor, grocer, butcher, plumber, your neighbors, the railroad and express offices, the police and the fire department—all these and 6,000 others can be placed within the reach of your voice for $1.50 per month. It will pay you to think of this—and get a telephone.

The Cleveland Telephone Company's Main Exchange is well worth a visit. Drop in and see it, and at the same time visit the office and get some facts about telephone service. If you can't spare the time, telephone Main 533, and someone will call on you.

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RESISTANCE AND PROPULSION OF SHIPS, by W. F. Durand. 8 vo., cloth, **$5.00**

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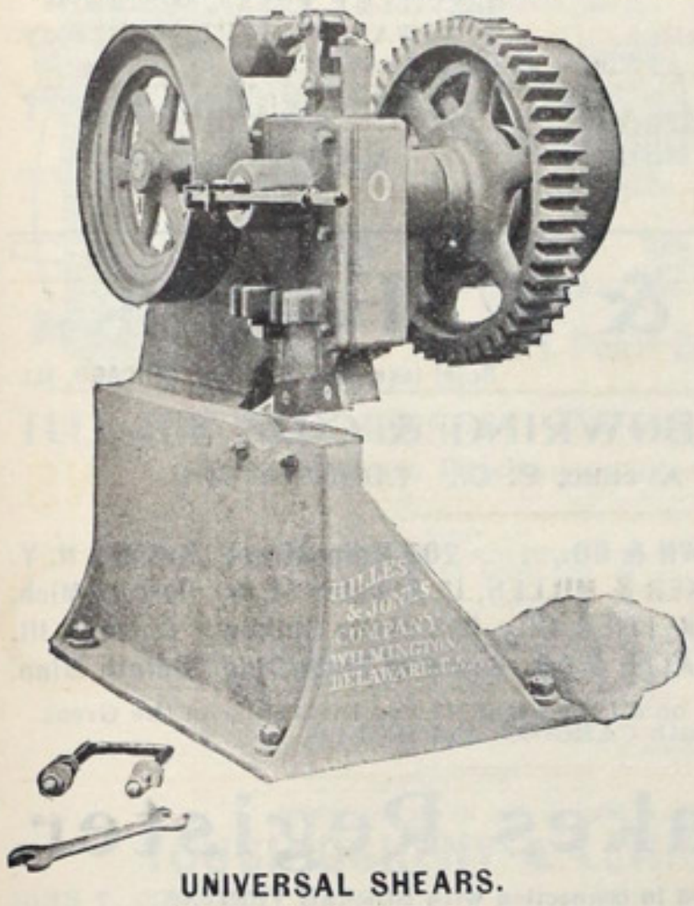
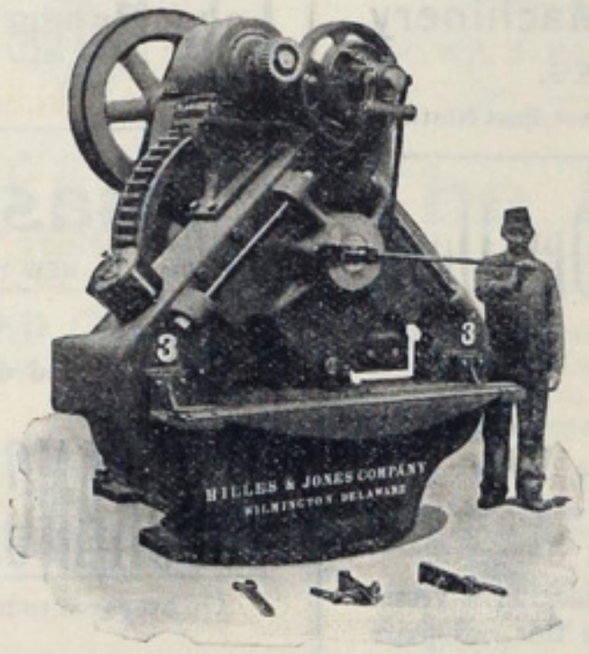


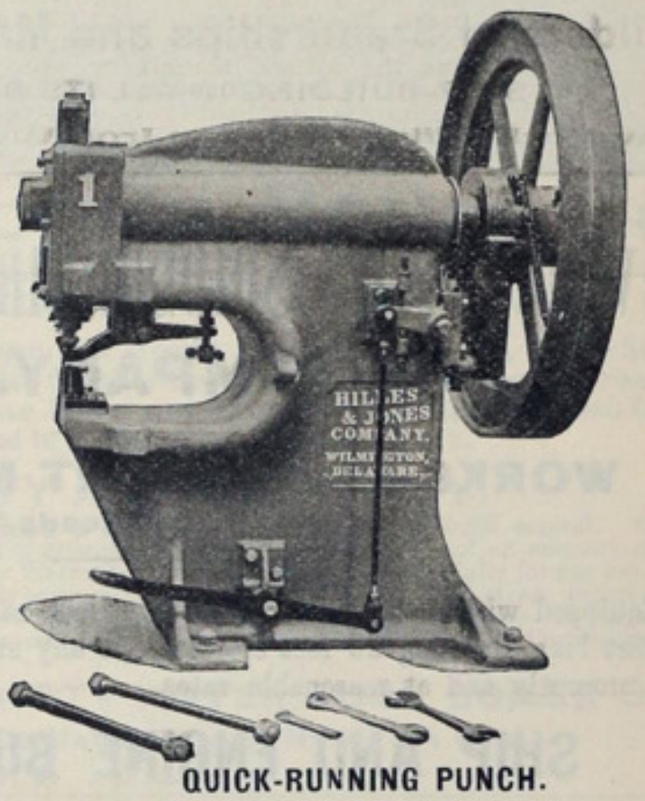
UNIVERSAL SHEARS.

For splitting plates of any width. Machines of this same design are built for work up to 1 inch in thickness. Main frames are made of steel to give ample clearance for the plate passing through and yet provide ample stiffness and strength.



DOUBLE ANGLE SHEARS.

These machines may be furnished with electric motor as shown in cut, steam engine or pulleys for driving as preferred. Same design in a number of sizes, larger and smaller.



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Intended for light work and for the convenient handling of structural material. Speed of the machine is about 75 strokes per minute. Die block is close to the front for convenience in handling light angles. Lighter and heavier machines of this same design are furnished.

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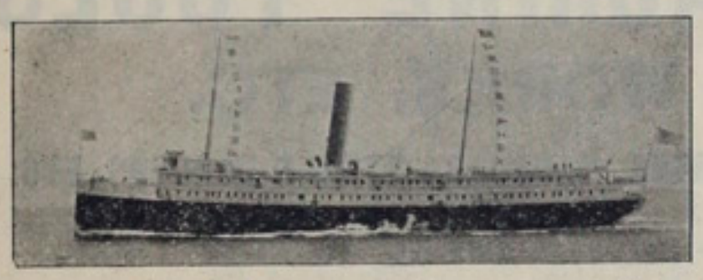

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NOTICE.—The Pro. Tug HELENE, owned by John W. Averill, Jr., burden about 12.50 tons, together with boilers, machinery, anchors, cables, furniture, tackle, and all appurtenances, will be sold from the west steps of the Post Office Building, Cleveland, Ohio, on Tuesday, November 29, 1898, at 10 o'clock, A. M. to satisfy an indebtedness of $7,700.00 of the National Bank of Commerce of Cleveland, Ohio, against said John W. Averill, Jr., under a certain mortgage, recorded Vol. 17, page 71, Office of Collector, Cleveland, Ohio. SQUIRE, SANDERS & DEMPSEY, Attorneys for National Bank of Commerce of Cleveland, Ohio.
Nov. 24.

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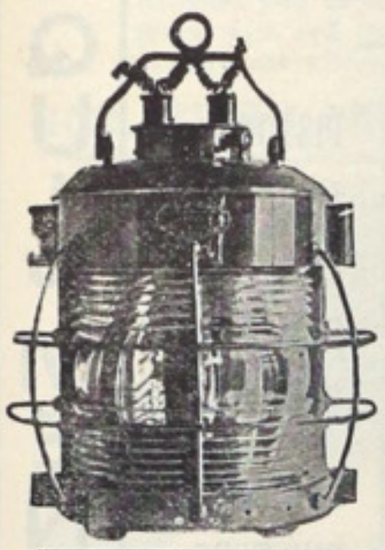
Nov. 24.

MARINE LAMPS



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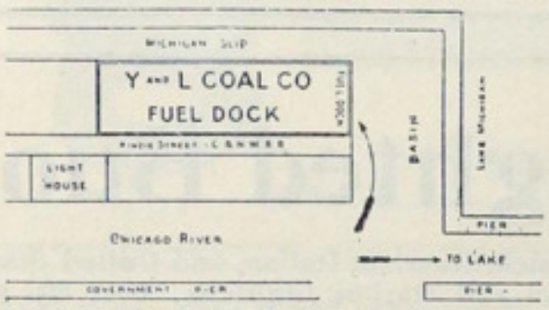

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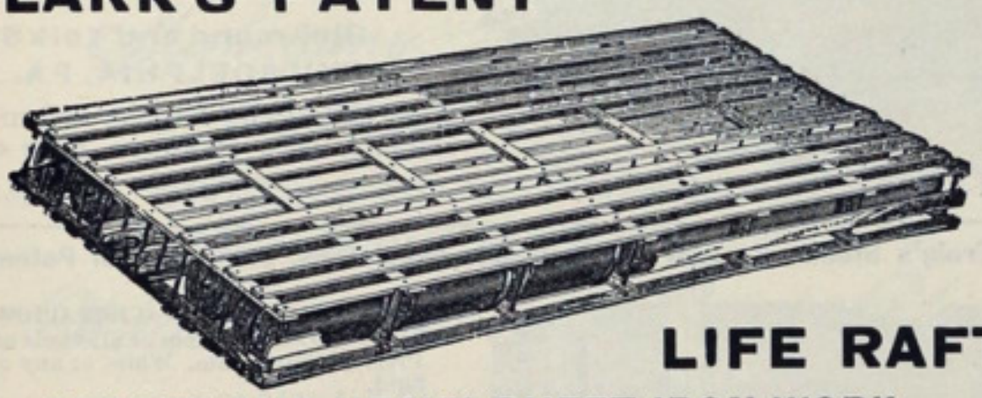

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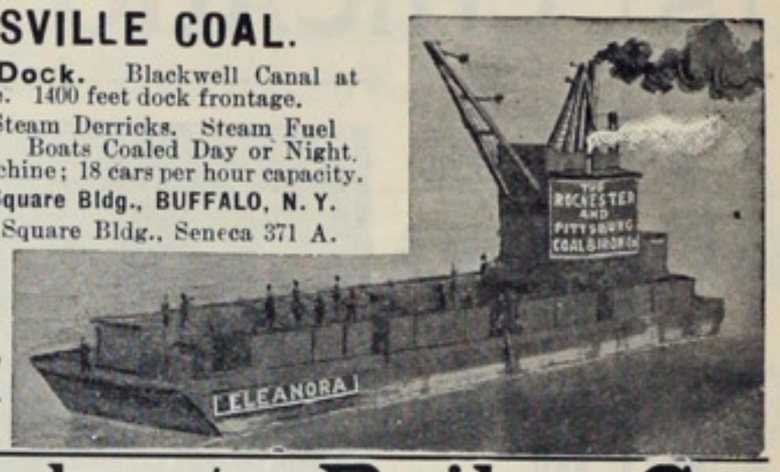

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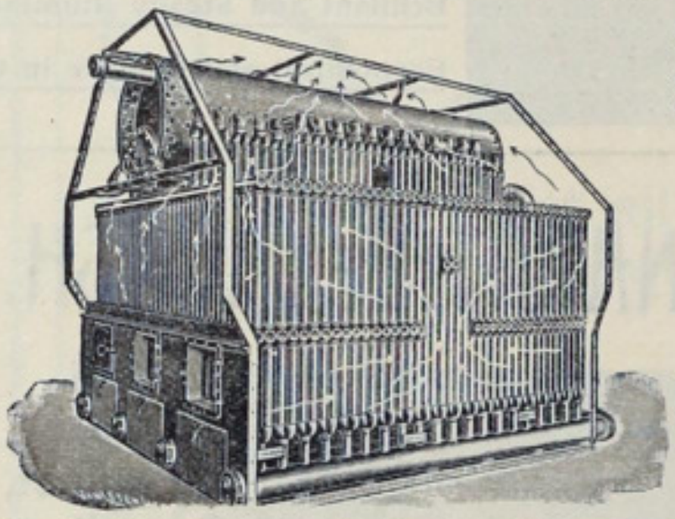

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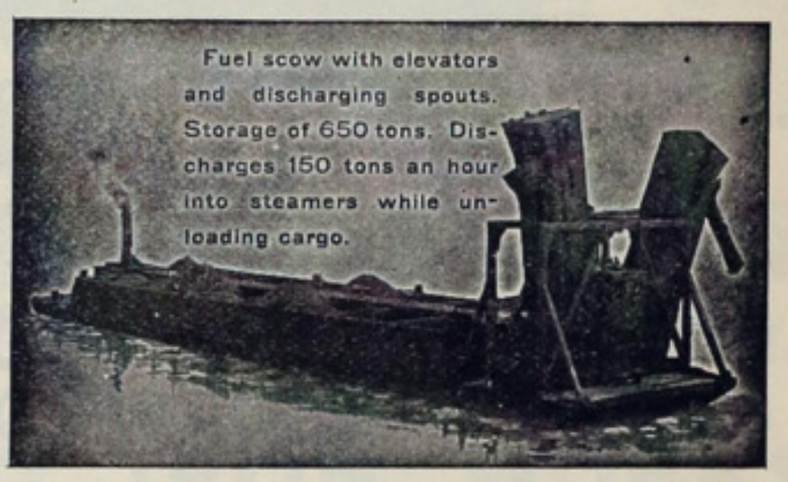

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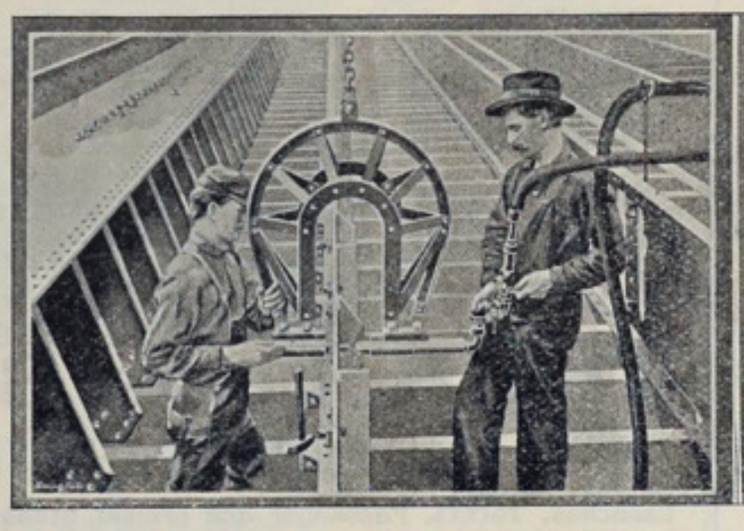

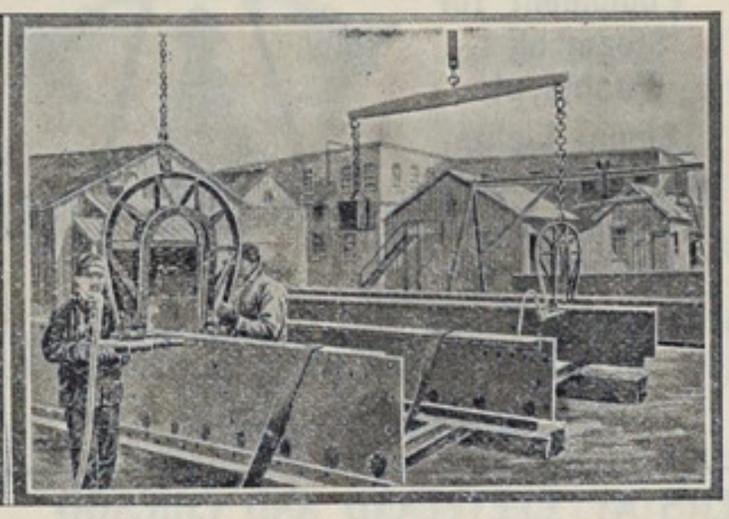

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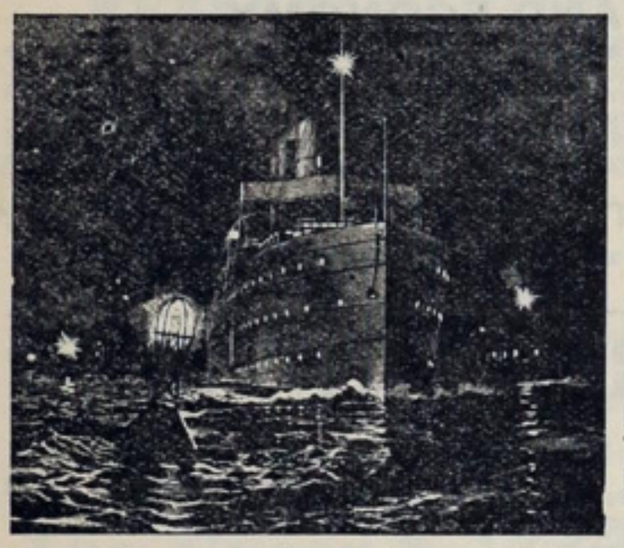

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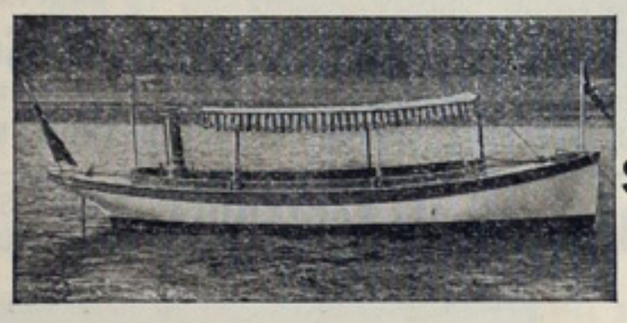

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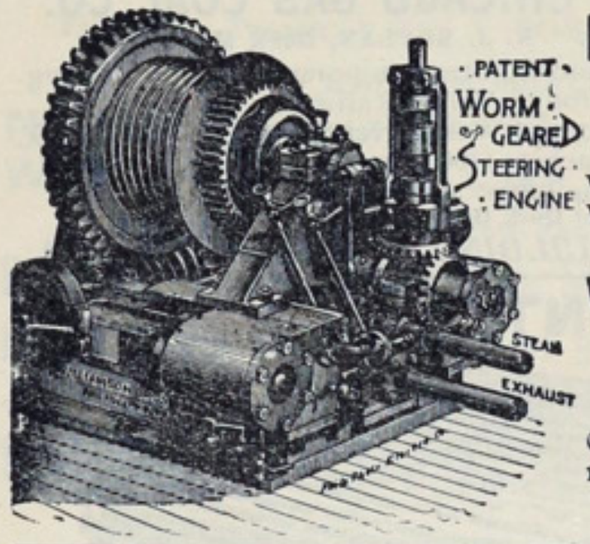

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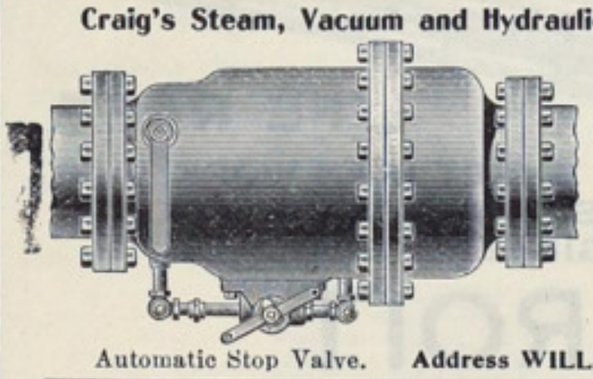

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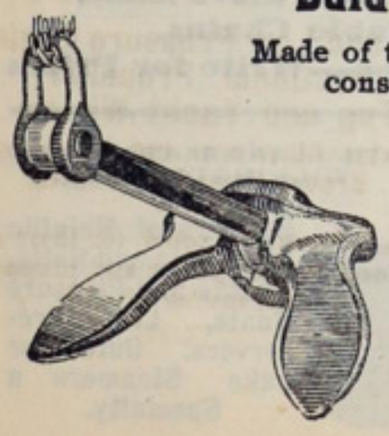

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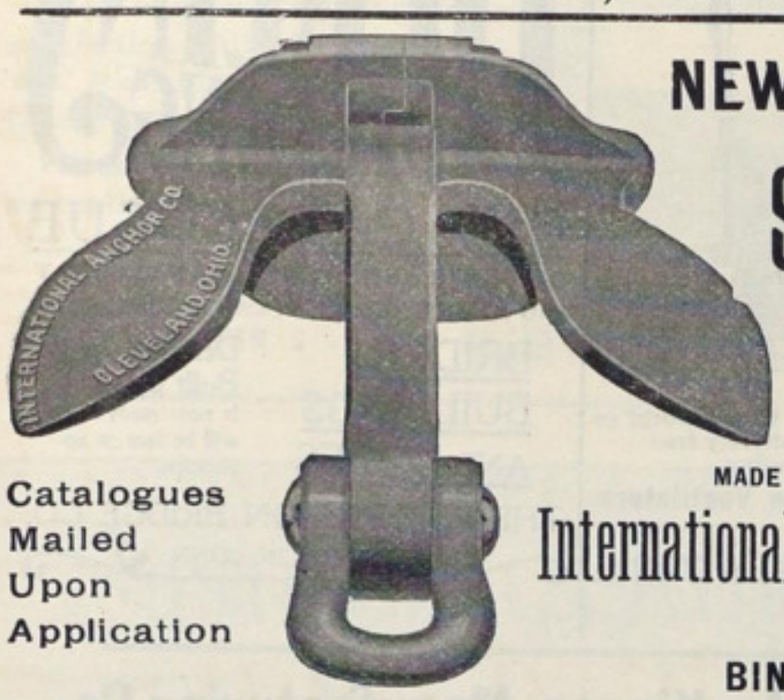

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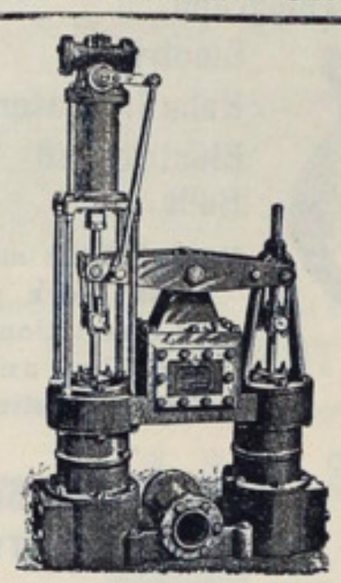

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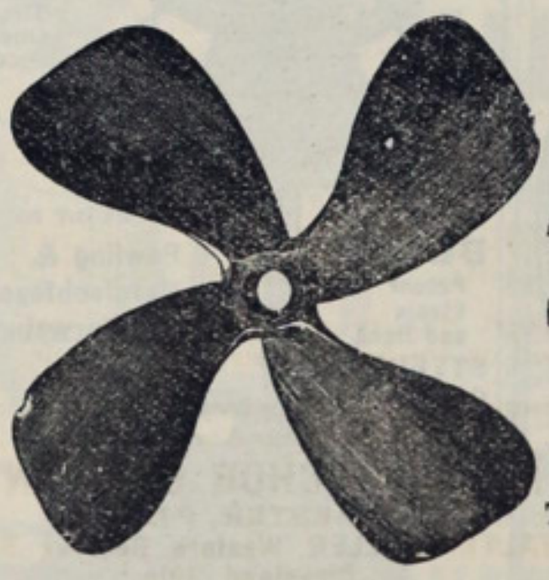

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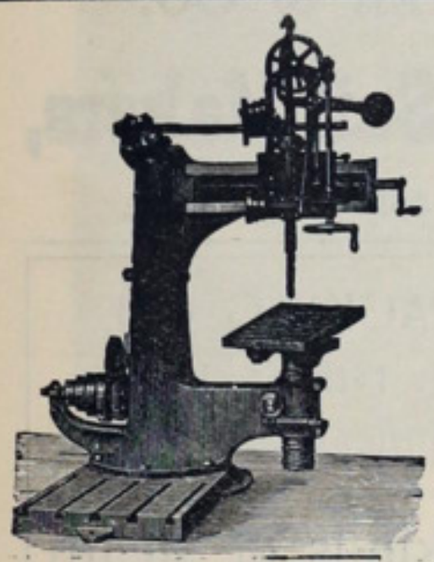

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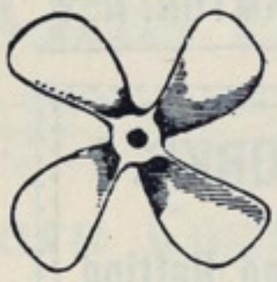

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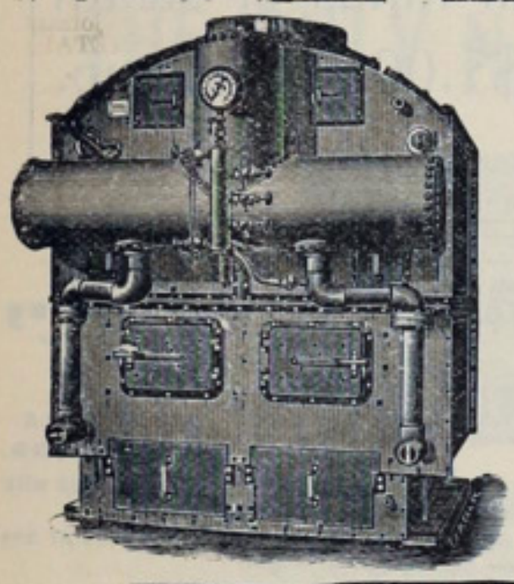

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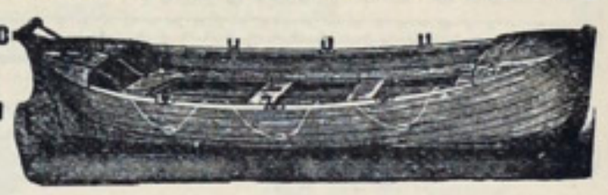

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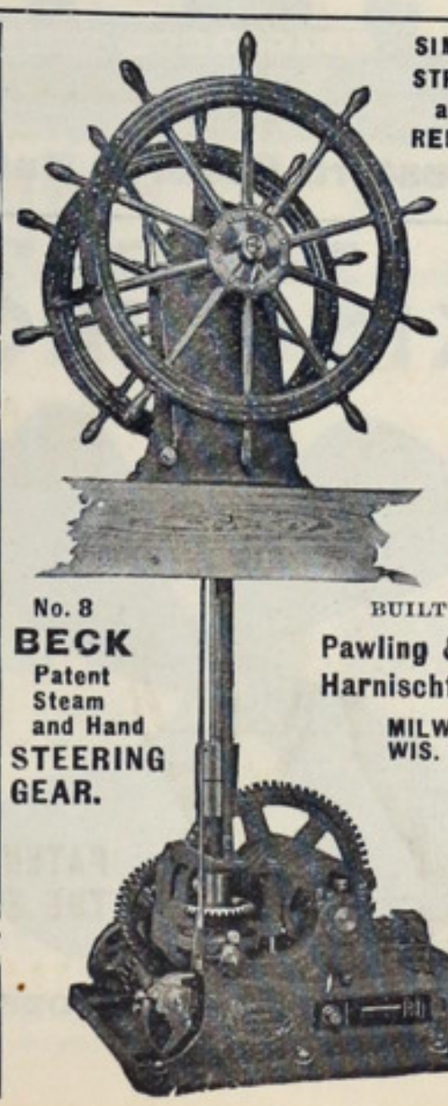

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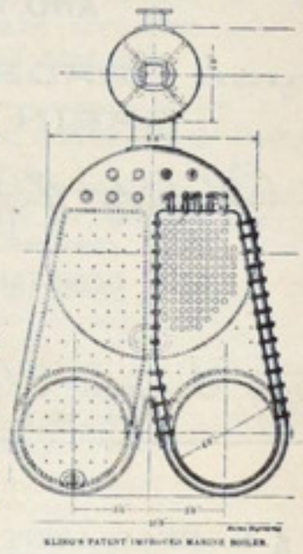

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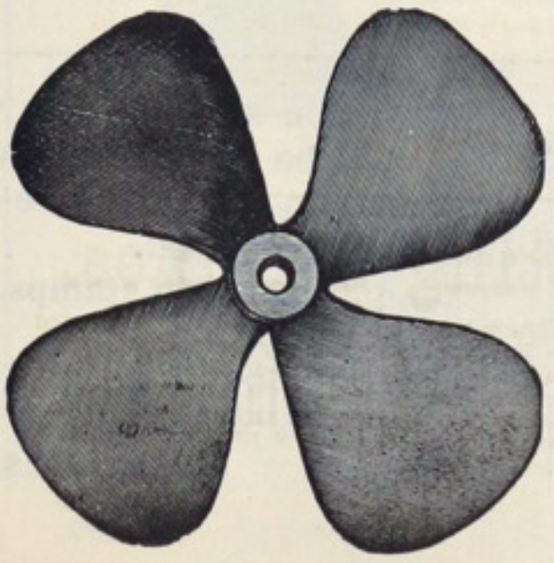

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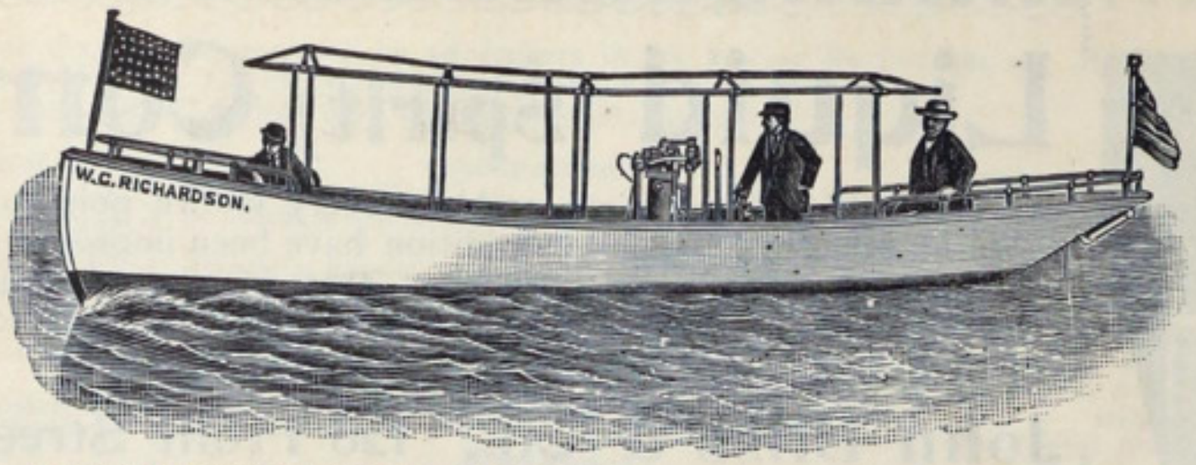

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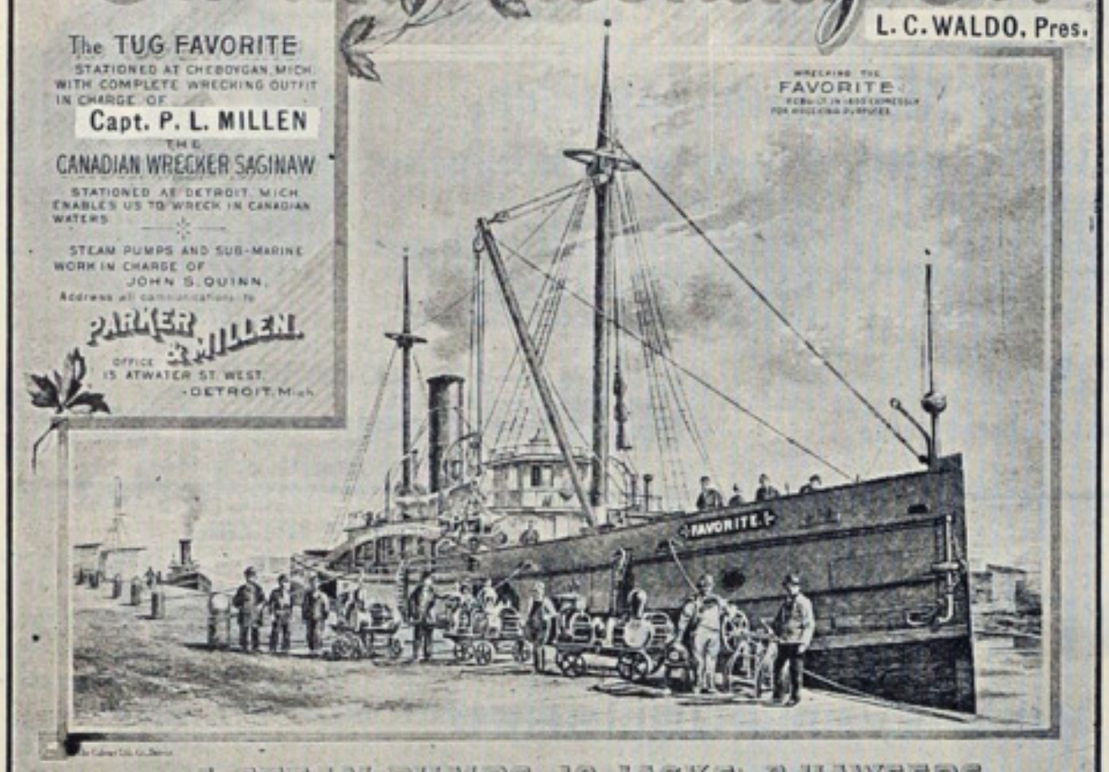

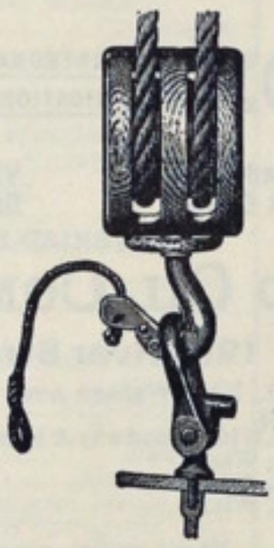

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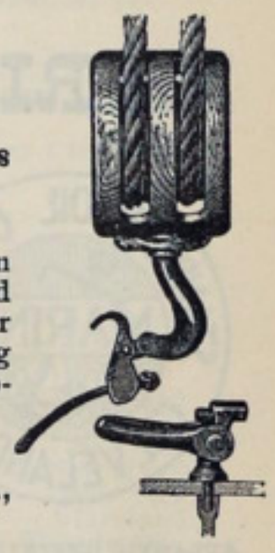

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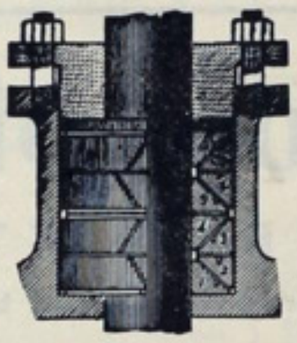

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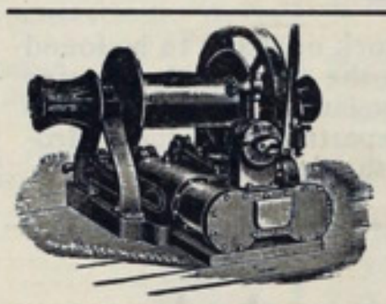

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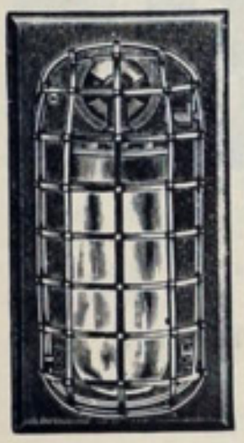

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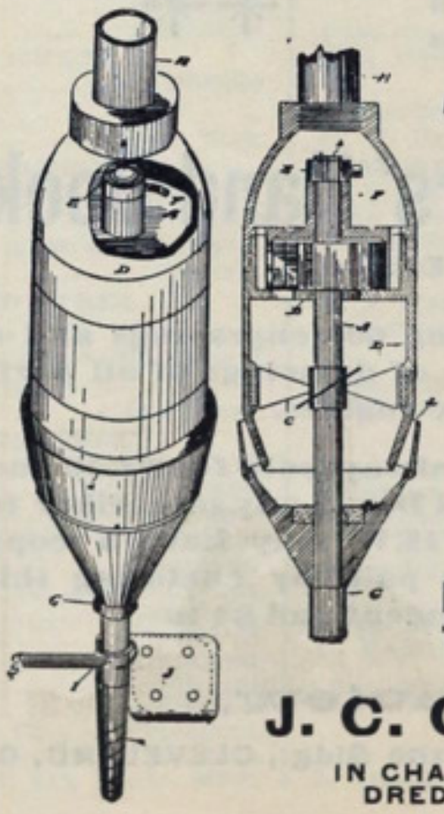

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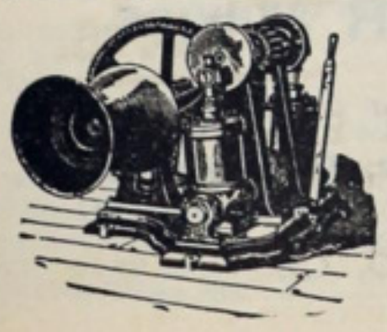

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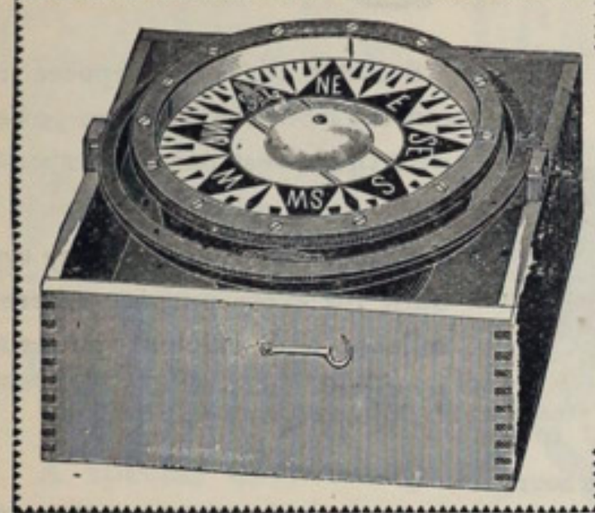

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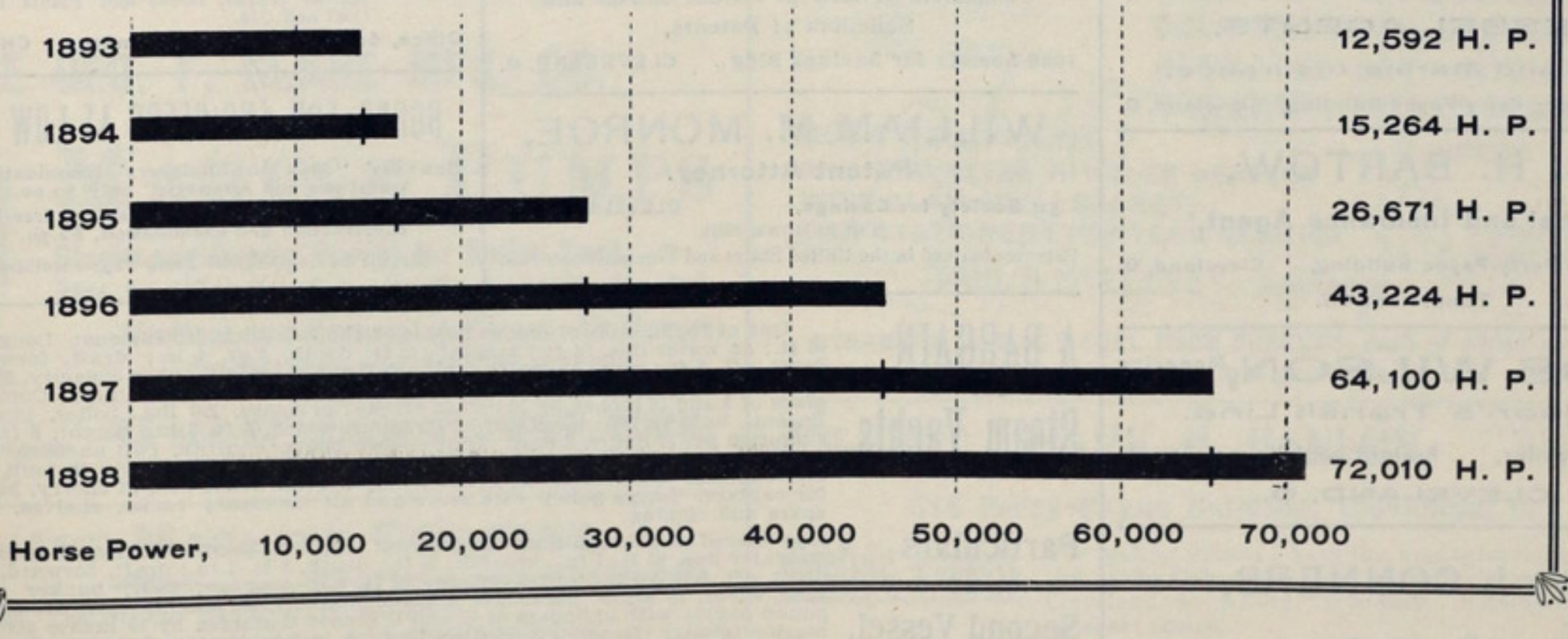
Total installations by Dry Dock Engine Works, Detroit,	58	72,010

Diagram showing Increase of Howden Equipment by Dry Dock Engine Works, Detroit.



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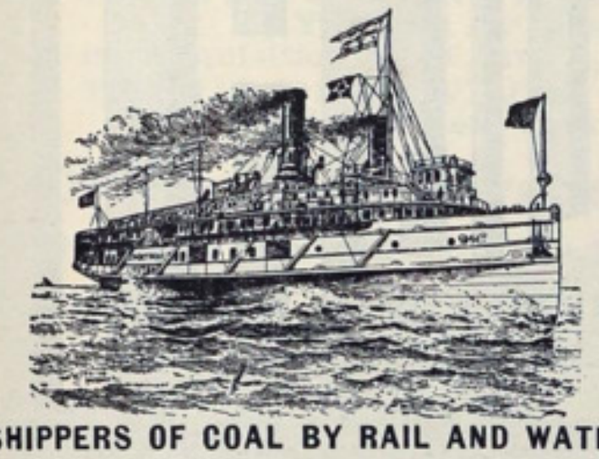

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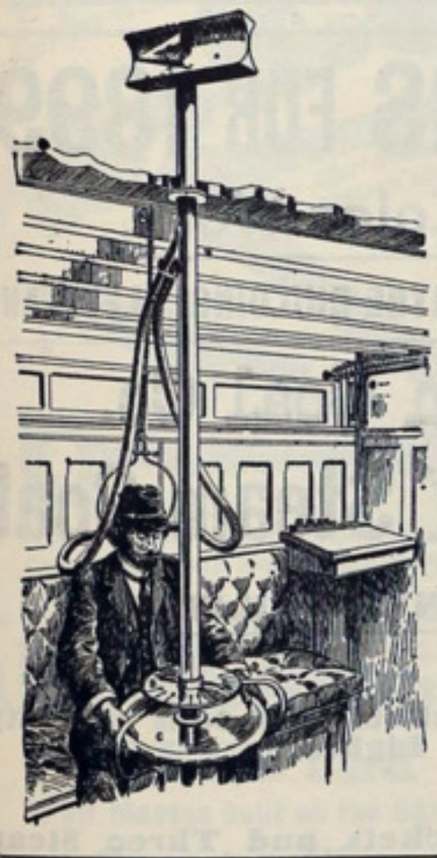

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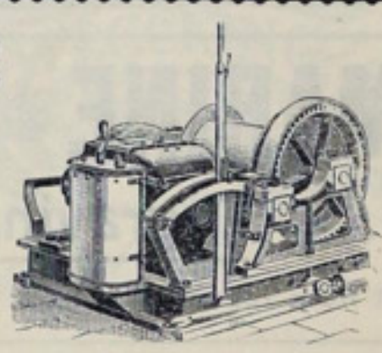

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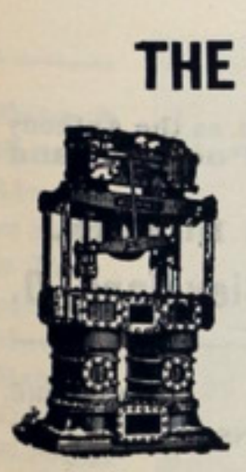

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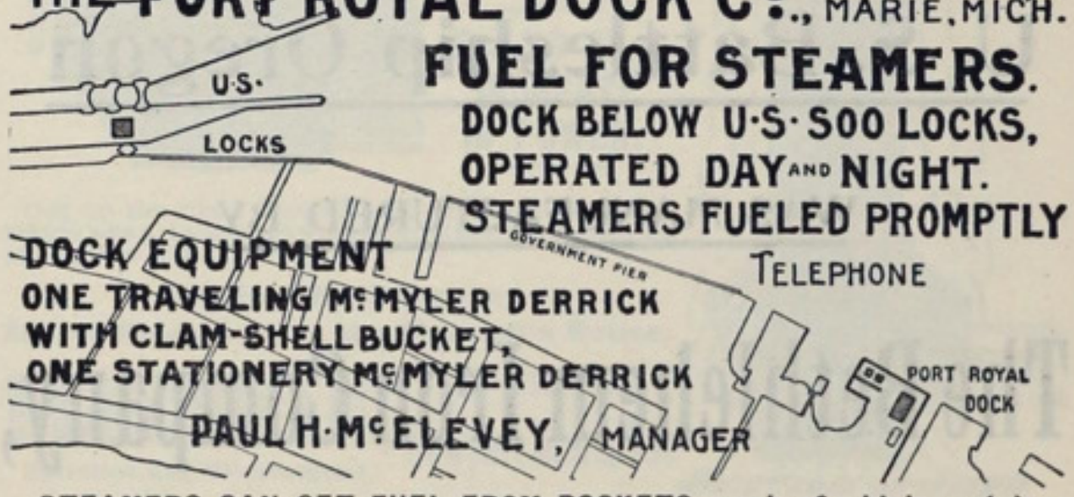

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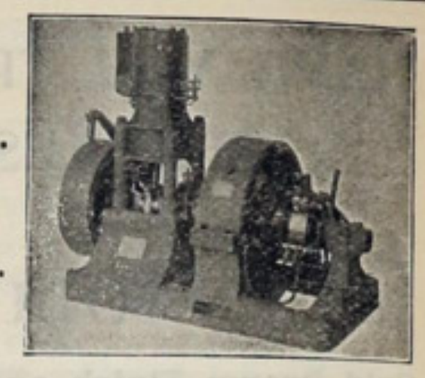

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June 10, 1898.

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THE BABCOCK & WILCOX CO.,
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(Sig.) EDWIN STEWART, Paymaster General,
U. S. N.

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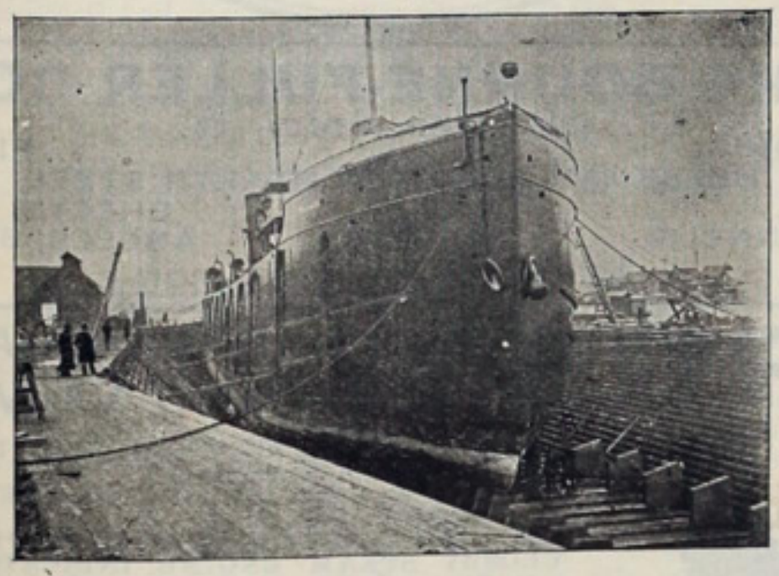

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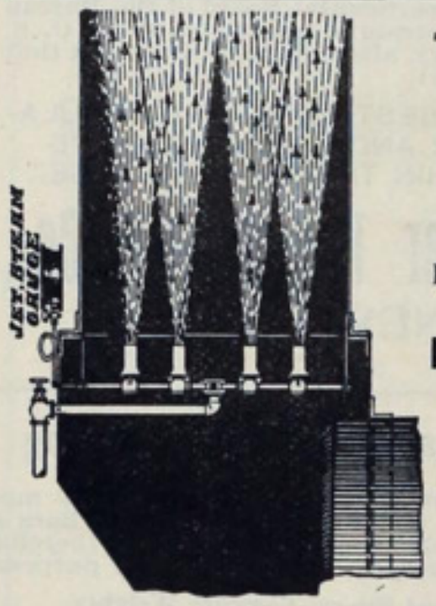

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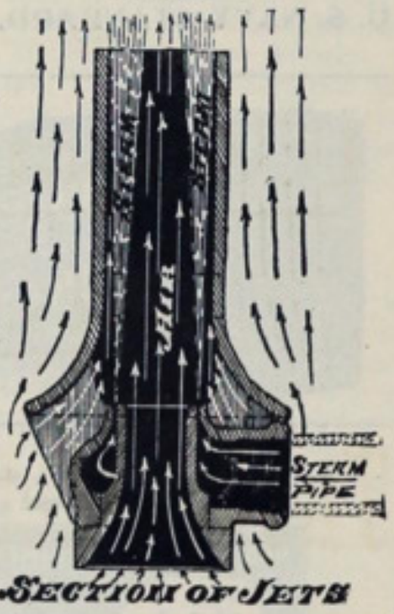

SECTION OF JETS

Cut on the right shows a section of Jet Castings, which are attached to Spider in stack, as shown by cut on the left.

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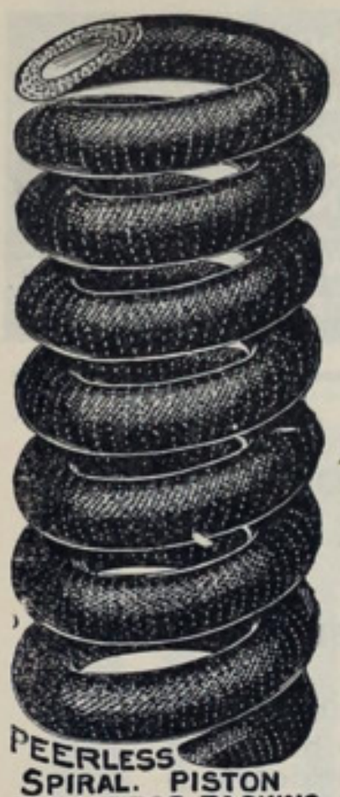

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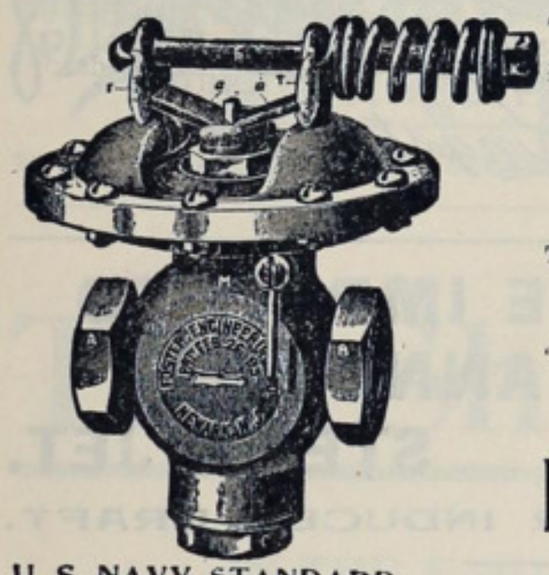

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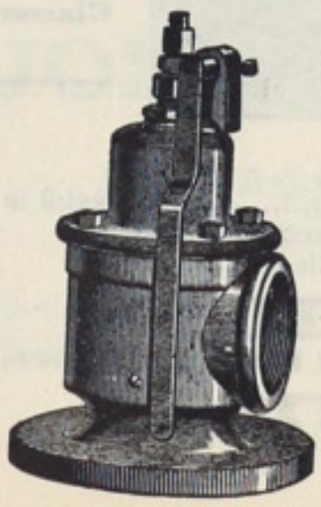

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